73 AMATEUR RADIO®

SEPTEMBER 1989
ISSUE #348
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Home-Brew Antennas for 160–10m!

Dual Band Beam
20–10m Vertical
Add 30m to Your W-4
Inverted "U" for 80m

REVIEWS:

Kenwood TS-680S HF Rig
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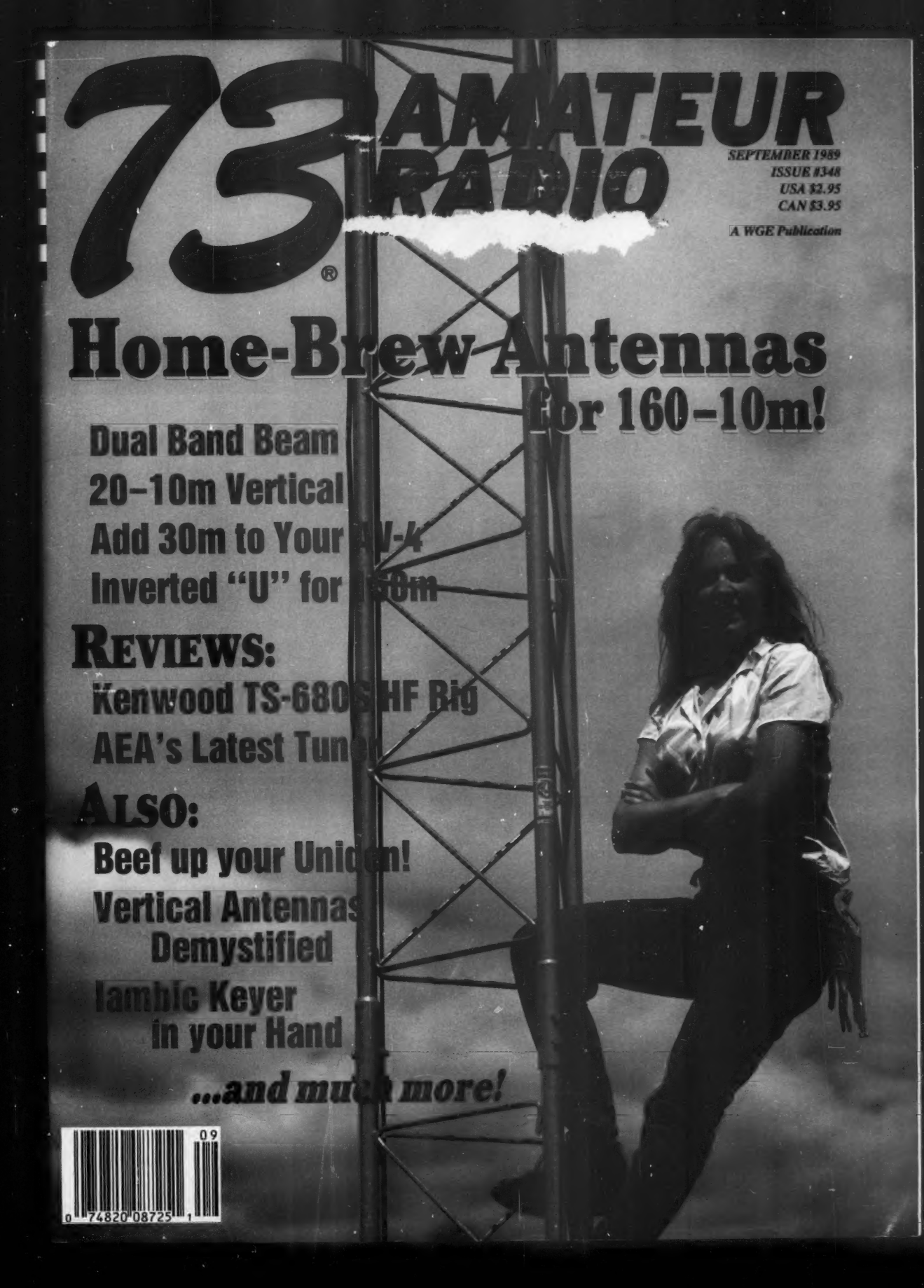
ALSO:

Beef up your Uniden!
Vertical Antennas Demystified
Iambic Keyer in your Hand

...and much more!



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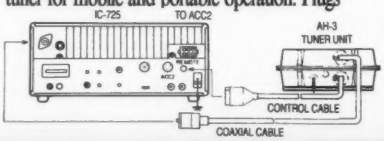

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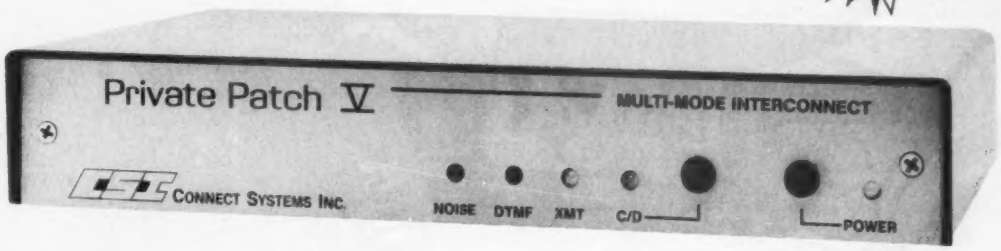

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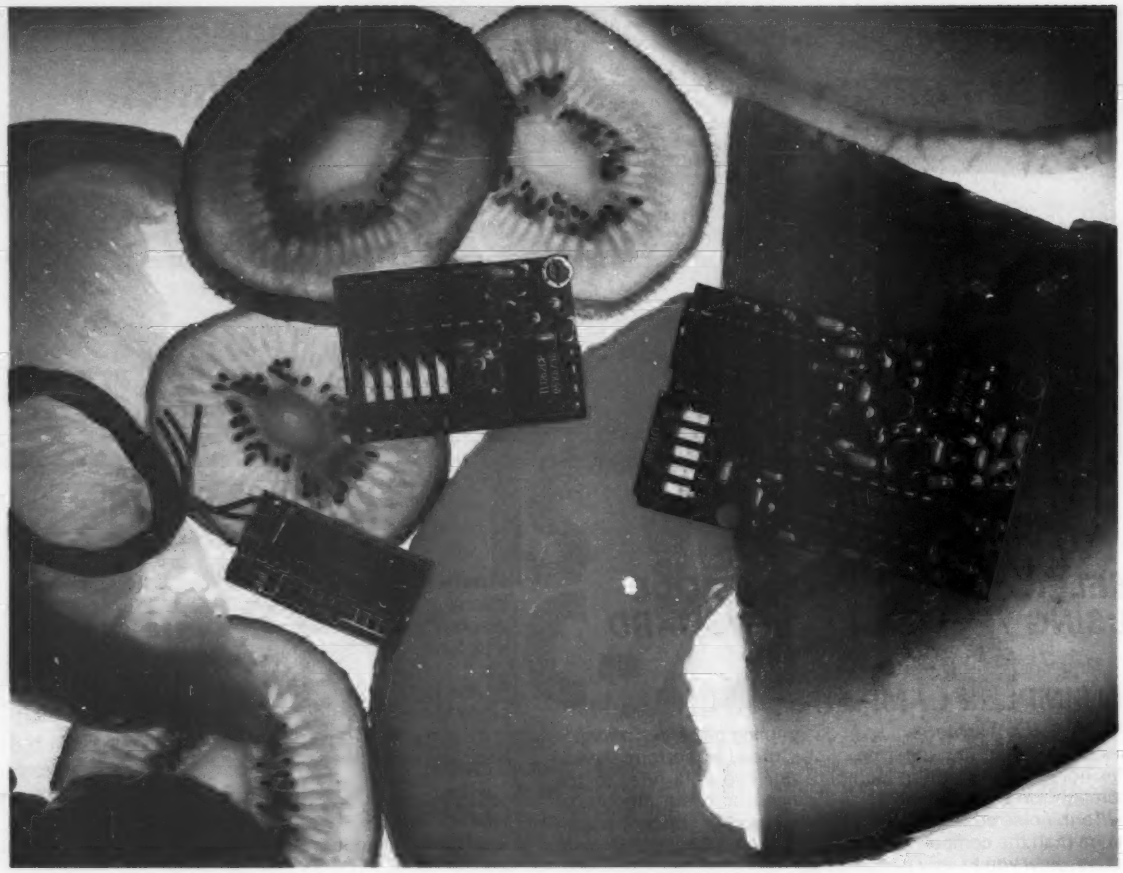

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Cover by Marilyn Moran; photo by Frank Cordelle
Tully Londner ascends the *73* tower to do a little work on the Sommer beam.

See page 33 to learn more about Kelly N6PNY.

Welcome, Newcomers!

A Special Kind of Circuit

Antennas range from a single length of wire to a complex array of metal tubing. Antennas come in many shapes and sizes, but the three most common kinds of ham antennas are the dipole, the vertical, and the yagi beam.

A circuit is called an antenna when it radiates (transmits) into the atmosphere radio frequency (RF) energy that passes through it and/or to intercepts (receives) electromagnetic waves.

Changing the physical length of the elements of an antenna is one way to change its **resonant frequency.** The antenna radiates and receives most efficiently at the resonant frequency. The longer the antenna elements, the lower the resonant frequency; the shorter the elements, the higher the frequency.

You can also tune (that is, change the resonant frequency of) your antenna by including a "trap," which consists of a capacitor and a coil, or only a coil. Using a trap, you change the **electrical length** of your antenna while keeping its physical length the same.

A horizontal antenna, such as a dipole, has horizontal **polarization.** Antennas whose elements are parallel to the earth tend to radiate horizontally. The yagi, the most common type of beam, may have horizontal, vertical, or slantwise polarization, depending on how it is rotated about its **boom** axis. A vertical antenna has vertical polarization.

Feedlines, Impedance, and SWR

The **feedline** connects the antenna to the transceiver. **Coax** is the most commonly used feedline. You can bend it, bury it, and run it next to metal objects. It's also weather-resistant and easy to get. Most importantly, its **impedance** closely matches that of the feedpoint of most antennas. **Ladder-line**, a parallel conductor feedline, is also popular because it can handle high power even with a significant **impedance** mismatch between transmitter and antenna, and typically conveys most of the RF energy going into it from the transmitter to the antenna feedpoint. We call this "low-loss." You can't bend ladder-line, or run it near metal objects, however, and it can't be connected to most transmitters without an **impedance matching circuit**.

The impedance of coax is 52Ω or 75Ω, while the impedance of parallel conductors runs 300Ω and higher. If you don't match the impedance of your antenna with the impedance of your transmitter, too much RF energy reflects back to your transmitter instead of being radiated. This can seriously damage your transmitter.

An SWR meter reading of 1:1 means that the most efficient transfer of power exists between the transmitter and the antenna. Generally, an SWR of more than 2:1 is too high.

HF Antennas

The dipole is inexpensive, easy to make, and adaptable. All you need is two equal lengths of wire cut the right length for the operating frequency, a center insulator, and a feedline with the appropriate connector.

The horizontal, inverted-V, and sloper dipoles are the most widely used ham antennas. However, the dipole requires at least two supports as high above the ground as possible, and a lot of space. For example, a **half-wave dipole** antenna for 80 meters would be 126 feet long; each segment would be 63 feet. You can shorten the dipole by adding a coil to each element.

Vertical antennas are also popular because they usually need only one support point, require little space, and sometimes outperform horizontal antennas on long distance contacts. They sometimes require long **radials**, however, which can demand a lot more real estate.

Beam antennas, such as the yagi, are commonly used for 40m and higher frequency band operation. The elements would be too long to be practical for 80 and 160 meter operation. A 3-element yagi has a director, a driven element, and a reflector, all attached crosswise to a boom. Increasing the number of directors increases the directivity and gain of the beam. Directional beam antennas have two main advantages: The directivity reduces the strength of signals from directions other than the one you point the antenna at, and they radiate your signals more where you want them to go.

Antenna Experimentation

Amateur radio operators have always been avid antenna experimenters. Besides the fun of innovation, many hams are motivated by practical considerations, such as legal and space restrictions, special environmental demands, money, and materials on hand.

In *73*, we feature unique home-brew antenna systems. Antenna experimentation is going strong, and it looks like it will continue for a long time to come. Not all the data is in yet.... Eds.

Glossary

Coax, coaxial cable A feedline that consists of a center conductor surrounded by insulation, that in turn is surrounded by a wire braid called the shield.

Boom The non-radiating piece of an antenna that directly supports the antenna elements. On a yagi, the elements cross the boom at 90° angles.

Electrical length The electrical length of an antenna is measured by the time it takes for a charge to travel to the end of the antenna and back in one cycle of the applied frequency. The electrical length and the physical length may be different. Besides length, other factors, such as nearby objects and insulating materials, affect the resonant frequency of an antenna.

Element That portion of the antenna that does the bulk of the RF radiation and coupling with incoming RF energy.

Feedline A cable that conducts RF energy between your transceiver and your antenna. Feedlines should radiate as little RF energy as possible. Where the feedline and antenna meet is called the *feedpoint*. Coax, twin lead, and ladder line are common feedlines (also called transmission lines).

Frequency The number of cycles of a radio wave that passes a given point in a given amount of time. The more cycles per second, the higher the frequency, and the shorter the wavelength. Frequency is usually given in *Hertz*. One Hertz is one cycle per second.

Half-wave dipole A horizontal antenna made by connecting two equal lengths of wire to the feedline at the center, where each length is a quarter wavelength of the operating frequency.

HF High Frequency. A section of the electromagnetic spectrum from 3–30 Megahertz (MHz). The 80–10 meter amateur bands are HF bands. Worldwide amateur communications occur most often on these bands.

Impedance The opposition a circuit offers to the flow of current. Impedance is measured in ohms, symbolized by the Greek letter Ω.

Impedance matching circuit A circuit that matches the input impedance of the antenna to the output impedance of the transmitter. The transmatch and balun are impedance matching devices.

Ladder line A twin-lead type of feedline constructed of bare wire with plastic spacers to keep the wire separate and parallel.

Polarization The orientation of the electromagnetic field of the antenna in relation to the earth. The electrical field of a wave is generally parallel with the active element(s) of the antenna.

Radials Lengths of wire that extend from the base of a vertical antenna in a radial pattern, to improve the efficiency of the antenna and lower its angle of radiation.

Radiation The act of RF energy leaving an antenna system and entering another medium, such as the atmosphere.

Resonant frequency The frequency at which the antenna performs best; that is, where it radiates the most efficiently and optimally receives such RF energy.

RF Abbreviation for "radio frequency energy." The RF portion of the electromagnetic spectrum ranges from about 20 kHz to 30 GHz, which is divided into eight frequency bands, from VLF (very low frequency) to EHF (extremely high frequency).

SWR The ratio of RF energy the antenna system radiates versus the RF energy the antenna system reflects back to the transmitter.

Transceiver A transmitter/receiver pair, usually contained in one box.

Twin lead A feedline that has two parallel conductors separated by a strip of insulation.

Wavelength The distance between one cycle peak and the next of an RF wave. For example, on the 80 meter band, the peak-to-peak distance is 80 meters. The higher the frequency, the less distance it will travel in one cycle.

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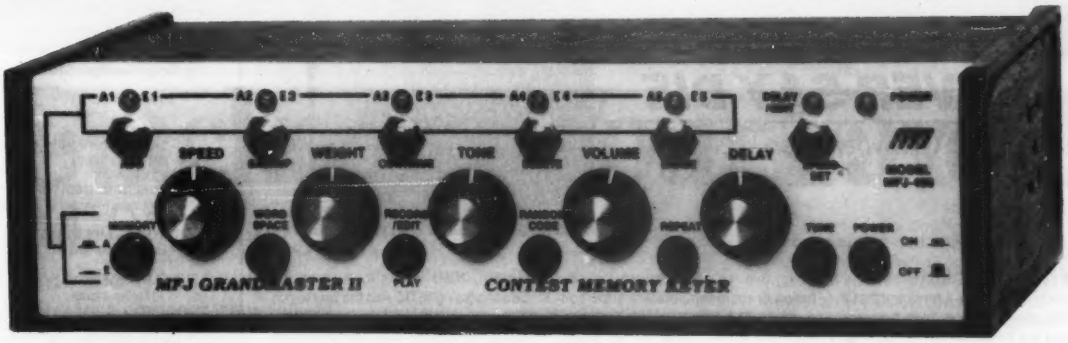

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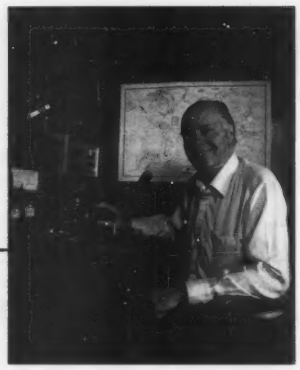

The Killer Blankets

Wouldn't you know, it turns out that it isn't the microwaves or high frequencies that are killing people as much as it's good old 60 cycles. Since you probably don't read the *New Yorker* magazine, you missed the fascinating series they published on the subject. You'll be reading about it everywhere from now on and seeing it on TV. This is going to outclass the Alar, radon and Chilian grape scares. Newsweek gave it a page (7/10 issue, page 71).

In case you prefer to go right to the bottom line and avoid reading the gory details, it turns out that people who live near power line distribution points or high tension wires are getting clobbered. Cancer, birth defects, miscarriages and so on. Other clobberees are people working around video terminals and those using electric blankets. Well, you can bet I unplugged my blanket and removed the cord even before I finished reading the series.

No, this isn't another case of cold fusion or room-temperature superconductivity. The *New Yorker* doesn't suck into technology scare stories easily. The series names the scientists and how much the power companies paid them to cover up the mess that's been discovered and is now unraveling.

It turns out it's low frequency magnetic fields which raise hell with living cells, much more than radio waves. Radio, if it's strong enough, cooks 'em. Low frequencies upset the ability of cells to function and replicate correctly. Worse, experiments have shown that the magnetic fields which affect cells can be far weaker than ever imagined! We're talking below one milligauss!

It's the 60 Hz vertical deflection coil in video terminals which does the dirty work. You sure don't want to work within a couple feet of those for long. The magnetic field from your electric blanket will gradually bollix your cells. Just living near a pole pig transformer can greatly elevate leukemia and cancer in you and your family.

What can we do besides panic? Well, panic is a good first step. The next step is to get busy and get your kids and grandchildren law degrees as quickly as you can so they can get in on the feeding frenzy of lawsuits the power companies are going to have over this. Yep, those SOBs know they are killing us. Just like the cigarette companies know they are, too. Well, how about Congress? Money talks with them, not lives.

So let's go to step three. We hams, being acknowledged electrical experts (haw, if they only knew how little the tens of thousands of Dick Bash graduates actually know about electricity or radio!), can help lead the world away from the destruction Nicola Tesla and his monster, alternating current, have wrought. It turns out Edison was right, DC was the way to go!

Now, how are we going to go about saving the world? Well, the devil is 60 Hz magnetic fields, so what we need to do is come up with some inexpensive gaussmeters which will measure magnetic fields so we can sweep our homes and businesses for dangerous levels. You thought radon was awful? AC seems to be killing even more people than cigarettes, and thousands of times more than radon.

So let's get our little ham hands busy designing and building gaussmeters. I'll publish your designs in *73* so we can get started helping our neighbors avoid further death and birth defects. I'm sure you'll do this philanthropic work out of the goodness of your heart and it will never even occur to you to go into business and charge for saving lives.

Hmm, you say, if this is such a danger, how come our media, which is always anxious to jump on even the slightest of scare bandwagons, has been so oddly silent? Newspapers and news magazines these days are totally dependent upon video terminals for writing, editing and page makeup. Worse, their video display terminals are often side by side, giving their staffs the worst possible barrage of these magnetic fields.

How about the TV reporters? And scare people into turning off their color TV sets? No way!

So we've had a conspiracy of silence by the media, fed by the fear of lawsuits by employees and the high cost of magnetically shielding their VDTs.

I'm sure glad I've been using laptops with LCD screens for the last ten years. And don't say I haven't been trying to get you to do the same.

The Paul Brodeur series, which is due out this fall in book form by Simon & Schuster, is called *Currents of Death: Power Lines, Computer Terminals and the Attempts to Cover Up Their Threat to Your Health.*

When you consider that life exists only because we have a replicating DNA molecule, which in turn is made up of arrays of hexagonal benzene-type rings, each a sub-microscopic electromagnetic circuit, it's not a big step to see how outside magnetic fields could have a profound effect on this very delicate replicating process.

Continued on page 68

QSL OF THE MONTH

To enter your QSL, mail it in an envelope to *73*, WGE Center, Forest Road, Hancock, NH 03449, Attn: QSL of the Month. Winners receive a one-year subscription (or extension) to *73*. Entries not in envelopes cannot be accepted.

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TM-231A/431A/531A

FM Mobile Transceiver

Looking for a compact transceiver for your mobile VHF and UHF operations? KENWOOD has a compact rig for each of the most popular VHF/UHF bands.

- **20 multi-function memory channels.** 20 memory channels allow storage of frequency, repeater offset, CTCSS frequency, frequency step, Tone On/Off status, CTCSS and REV.
- **High performance—high power! 50W (TM-231A), 35W (TM-431A) with a 3 position power switch (high, medium, low).**
- **Optional full-function remote controller (RC-20).** A full-function remote controller using the Kenwood bus line, model RC-20, may be easily connected to the TM-231A/431A/531A and can be mounted in any convenient location. Using the IF-20 interface the RC-20 may be connected to four mobile transceivers. (TM-231A/431A/531A or the TM-701A)
- **Multi-function DTMF mic. supplied.** Controls are provided on the microphone for CALL (Call Channel), VFO, MR (Memory Call or to change the memory channel) and a programmable function key. The programmable key can be used to control one of the following on the radio: MHz, T. ALT. TONE, REV, DRS, LOW or MONITOR.
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- **Auto repeater offset on 144 and 220 MHz.**
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  a) Selection of the frequency step (5, 10, 15, 20, 12.5, 25kHz)
  *TM-531A: 10, 20, 12.5 25kHz
  b) Programmable VFO
  The user friendly programmable VFO allows the operator to select and program variable tuning ranges in 1 MHz band increments.
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- **Easy-to-operate multi-mode scanning.** Band scan, Program band scan, Memory scan plus programmable memory channel lock-out, with time operated or carrier operated stop.
- **Priority alert.**
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- **Automatic lock tuning function (TM-531A).**
- **Repeater reverse switch.**

Optional Accessories

- **RC-20** Full-function remote controller
- **RC-10** Multi-function remote controller
- **IF-20** Interface unit handset • **DRU-1** Digital recording unit • **MC-44** Multi-function hand mic. • **MC-44DM** Multi-function hand mic. with auto-patch • **MC-48B** 16-key DTMF hand mic. • **MC-55** 8-pin mobile mic.
- **MC-60A/80/85** Desk-top mics. • **MA-700** Dual band (2m/70cm) mobile antenna (mount not supplied) • **SP-41** Compact mobile speaker • **SP-50B** Mobile speaker • **PS-430** Power supply • **PS-50** Heavy-duty power supply • **MB-201** Mobile mount • **PG-2N** Power cable • **PG-3B** DC line noise filter
- **PG-4H** Interface connecting cable • **PG-4J** Extension cable kit • **TSU-6** CTCSS unit

Specifications and prices subject to change without notice or obligation.
Complete service manuals are available for all Kenwood transceivers and most accessories.

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All-mode tri-bander!

TS-790A

Satellite Transceiver

The new Kenwood TS-790A VHF/UHF all-mode tri-band transceiver is designed for the VHF/UHF and satellite "power user." The new TS-790A is an all-mode 144/450/1200 MHz transceiver with many special enhancements such as automatic uplink/downlink tracking. Other features include dual receive, automatic mode selection, automatic repeater offset selection for FM repeater use, VFO or quick step channel tuning, direct keyboard frequency entry, 59 memory channels (10 channels for separate receive and transmit frequency storage), multiple scanning and multiple scan stop modes. The Automatic Lock Tuning (ALT) on 1200 MHz eliminates frequency drift. Power output is 45 watts on 144 MHz, 40 watts on 450 MHz, and 10 watts on 1200 MHz. (The 1200 MHz section is an optional module.)

- **High stability VFO.** The dual digital VFOs feature rock-stable TCXO (temperature compensated crystal oscillator) circuitry, with frequency stability of ±3 ppm.
- **Operates on 13.8 VDC.** Perfect for mountain-top DXpeditions!
- **The mode switches confirm USB, LSB, CW, or FM selection with Morse Code.**
- **Dual Watch allows reception of two bands at the same time.**
- **Automatic mode and automatic repeater offset selection.**
- **Direct keyboard frequency entry.**
- **59 multi-function memory channels.** Store frequency, mode, tone information, offset, and quick step function. Ten memory channels for "odd split."
- **CTCSS encoder built-in.** Optional TSU-5 enables sub-tone decode.
- **Memory scroll function.** This feature allows you to check memory contents without changing the VFO frequency.
- **Multiple scanning functions.** Memory channel lock-out is also provided.
- **ALT—Automatic Lock Tuning—on 1200 MHz eliminates drift!**
- **500 Hz CW filter built-in.**
- **Packet radio connector.**
- **Interference reduction controls:** 10 dB RF attenuator on 2m, noise blanker, IF shift, selectable AGC, all mode squelch.
- **Other useful controls:** RF power output control, speech processor, dual muting, frequency lock switch, RIT.
- **Voice synthesizer option.**
- **Computer control option.**

Optional Accessories:
• **PS-31** Power supply • **SP-31** External speaker • **UT-10** 1200 MHz module • **VS-2** Voice synthesizer unit • **TSU-5** Programmable CTCSS decoder • **IF-232C** Computer interface • **MC-60A/MC-80/MC-85** Desk mics • **HS-5/HS-6** Headphones • **MC-43S** Hand mic • **PG-2S** Extra DC cable

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QRX . . .

EDITED BY BRYAN HASTINGS NS1B

Home-Brew IV

Thanks to the *hundreds* of authors who responded with construction articles for the Home-Brew IV contest! At the end of July, the four-ham committee spent hours carefully evaluating each and every entry. Look for the winning three articles in the November issue.

Generations are bridged through ham education. These proud sixth graders from Payson Arizona show off their totally home-brew deluxe crystal sets, containing nearly a dozen components. Their Elmers are William "Pete" Pedersen W7KTK and Jim Gray W1XU, 73's own Propagation columnist.

Radiation Hazard Seminar

The first-ever Doctors' Panel on Radiation Hazards and Amateur Radio will take place the weekend of August 25–27 at the ARRL Southwestern Division Convention, Airport Hilton Hotel in Los Angeles. The effect of non-ionizing radiation on the human body is a growing concern.

The event will be hosted by Dr. Wayne Overbeck N6NB, 1980 Radio Amateur of the Year. The panel will consists of four very prominent MDs. The first is Dr. W. Ross Adey K6UI, the world's premier researcher on the effects of electromagnetic radiation on the communication between living cells. The second is Dr. Samuel Milham, one of the world's most widely quoted epidemiologists, who found that people who work in electrical/electronic occupations have about double the average mortality rate from lymphatic cancer and leukemia.

The third is Dr. Ivan Shulman WC2S, a cancer surgeon who will discuss measures amateurs can take to minimize their exposure to electromagnetic radiation without abandoning their hobby. Dr. David Rodman KN2M, an ophthalmologist who has conducted extensive field measurements of both RF and 60-Hz magnetic fields surrounding amateur radio stations, will discuss his findings and methods of modeling E-M radiation hazards with computer software.

Never before has a panel with this much expertise on the hazards of E-M radiation been assembled anywhere but at a professional conference for specialists in this exotic field. Those interested in attending should make reservations by writing to: Hamcon '89, PO Box 18201, Encino CA 91416-8201. Admission price to the convention and all technical sessions is $12.

Dayscholar Winners

Ted Holmes N8ZM, President of the Dayton Amateur Radio Association, announced the four youngsters who are winners of the DARA 1989 Scholarships. They are Laurie Sandell N2FSO of Larchmont, New York, Lesley Walker N4FTJ of Cullman Alabama, Cynthia Gauthier N5KLQ of Pineville, Louisiana, and Jon Kidder KB8FQL of Wilmington, Ohio. Kidder will receive the newly created Robert F. Zimmerman Memorial Scholarship. Zimmerman, a long-time supporter of DARA and the scholarship program, passed away just before the 1989 Hamvention.

Each winner receives $1,000 to apply toward tuition at a school of their choice. These awards are an annual event, and the program is open to any licensed amateur graduating from high school in the year the award is given. There are no restrictions in the student's course of study or his/her license class.

Applications for the 1990 scholarship program will be accepted after January 1, 1990. For further information, write to the DARA Scholarship Committee, 317 Ernst Avenue, Dayton OH 45405.

Kenwood BBS

More and more electronic bulletin board systems are serving amateur radio. The Kenwood Communications and Test Equipment Group BBS is now available to any ham with a computer and modem. System parameters are 300/1200/2400 baud, 8 bits, 1 stop bit, and no parity. The BBS features amateur information, news, and programs. Access it at (213) 761-8284, 5 PM–8 AM PST Monday through Friday and all weekend.

220 Marches On

On 9 July, radio amateurs marched in various cities across the US to protest the FCC action that resulted in the reallocation of 220–222 MHz to commercial interests. The march was surprisingly successful in some cities, in light of the fact that US hams have little history of protest activities.

Perhaps the biggest success story was in Omaha, Nebraska, where over 50 people turned out for the march. John Gebuhr WB0CMC noted that all of the media—radio, television, and print—covered the Omaha event. In Cincinnati, Paul Oldaker NS8I reported that the march was also a success, with about 50 participants and some media coverage. About 20 hams and other supporters turned out for the Chicago protest.

Curiously enough, protest activity fizzled in a state that stands to suffer the most from the spectrum loss. Marches in Los Angeles and San Francisco never got off the ground, due to political conflict and lack of organization.

Thanks to the protesters in marches in other cities who took part in this 9 July event but don't appear by name in this report.

FCC Fees

The House Energy and Commerce Committee voted 13 July to levy licensing fees on ham radio operators and satellite-launching companies, and to increase fees on communications businesses. The action aims to reduce the federal budget deficit by $50 million.

By this bill, existing licensing fees charged by the FCC will go up an average of 12.6 percent and 17 communications areas that were exempted will have fees instituted, ranging from $30 for an amateur radio license to $70,000 for a permit to launch a satellite. FCC fines, unchanged since 1934, will also increase.

About a third of the anticipated $50 million will come from private radio operations such as rural radio, national paging services, offshore, mobile and amateur radio, and cellular phones. At this time, both the General Mobile Radio Service and Class D Citizens Radio are exempted.

Thanx

Thanks to *Westlink Report*, *ARRL Gateway*, *Television Broadcast Magazine*, and K9XI for providing items for this month's QRX. Keep your ham radio-related news items and photos rolling in to *73 Magazine*, WGE Center, Forest Rd., Hancock, NH 03449, Attn: QRX. You may also submit text to the /QRX SIG on the the 73 BBS, (603) 525-4438, 300/1200 baud, 8 data bits, no parity, and one stop bit.

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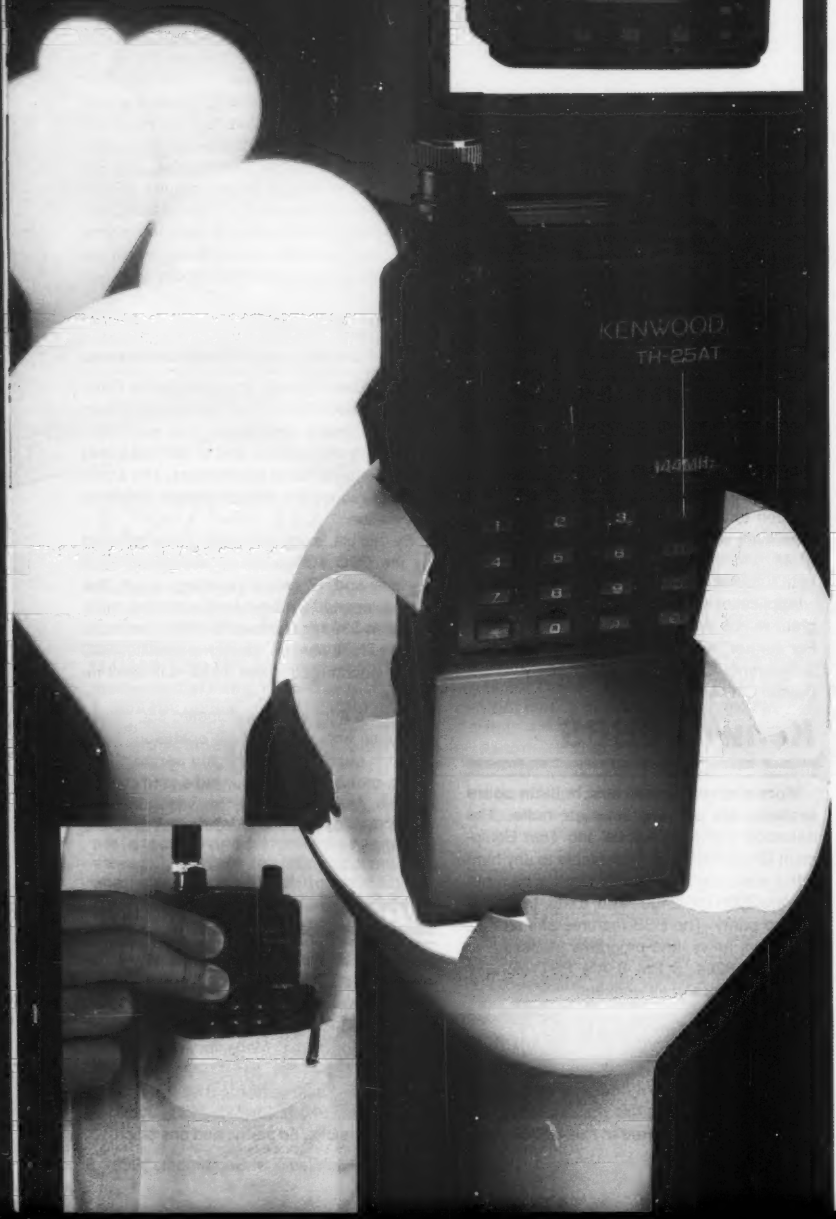

TH-25AT/45AT

New Pocket Portable Transceivers

The all-new TH-25 Series of pocket transceivers is here! Wide-band frequency coverage, LCD display, 5 watt option, plus...

- Frequency coverage: **TH-25AT:** 141-163 MHz (Rx); 144-148 MHz (Tx). (Modifiable for MARS/CAP. Permits required.)
  TH-45AT: 438-450 MHz.
- Automatic Power Control (APC) circuit for reliable RF output and final protection.
- 14 memories; two for **any** "odd split" (5 kHz steps).
- Automatic offset selection (TH-25AT).
- 5 Watts from 12 VDC or PB-8 battery pack.
- Large multi-function LCD display.
- Rotary dial selects memory, frequency, CTCSS and scan direction.
- T-ALERT for quiet monitoring. Tone Alert beeps when squelch is opened.
- Band scan and memory scan.
- Automatic "power off" circuit.
- Water resistant.
- CTCSS encoder/decoder optional (TSU-6).
- **Supplied accessories:** StubbyDuk, PB-6 battery pack for 2.5 watts output, wall charger, belt hook, wrist strap, water resistant dust caps.

Optional accessories:

• **PB-5** 7.2 V, 200 mAh NiCd pack for 2.5 W output • **PB-6** 7.2 V, 600 mAh NiCd pack • **PB-7** 7.2 V, 1100 mAh NiCd pack • **PB-8** 12 V, 600 mAh NiCd for 5 W output • **PB-9** 7.2 V, 600 mAh NiCd with built-in charger • **BC-10** Compact charger • **BC-11** Rapid charger • **BT-6** AAA battery case • **DC-1/PG-2V** DC adapter • **HMC-2** Headset with VOX and PTT • **SC-14, 15, 16** Soft cases • **SMC-30/31** Speaker mics. • **TSU-6** CTCSS decode unit • **WR-1** Water resistant bag

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Build a 30 Meter Trap

Modify your Cushcraft AV-4 or AV-5 for 30 meters.

by Gregory McIntire KE0UV

Many new rigs include the WARC bands, and many older rigs are easily enough modified for these new bands. Why are they then still relatively unused? Because many pre-WARC HF antennas won't adequately load on these new bands!

My Cushcraft AV-5 trap vertical worked just fine on five bands, but it wouldn't even HEAR stations on 30 meters, let alone tune up properly for transmitting. My solution was to build a 30 meter trap.

Hard-Earned Lessons

I had, in the past, tried to build an entire four-band trap vertical. The results were discouraging, but I learned a lot:

- A trap MUST be resonant at the frequency of interest.
- The components comprising the trap must be of adequate rating.
- The trap must be positioned in the antenna in the proper place. Be sure to resonate the trap properly.

This time I tried two different coil form materials: PVC plastic tubing, and wood. They worked about the same, but I chose the wood because of its strength and heat resistance. According to my reference materials, wood also has a dielectric constant as favorable as PVC.

For the coil, I tried #16, #14, and #12 wire. The number #16 wire got too warm at 100 watts of transmitted power. The #14 seemed satisfactory, but I chose the #12 for added margin, and it worked flawlessly.

For the capacitor, I first tried a 500 volt mica cap. It lasted about two or three seconds! I didn't have any higher rated caps, so I finally tried a length of coax cable. The ARRL *Handbook*, as well as various other sources, gives the capacitance per foot of various different types of coax. I chose Belden "Mini 8" (stamped as 9258) because of its relatively high capacitance per foot, and its voltage and current handling capabilities (100W) were adequate for my purposes.

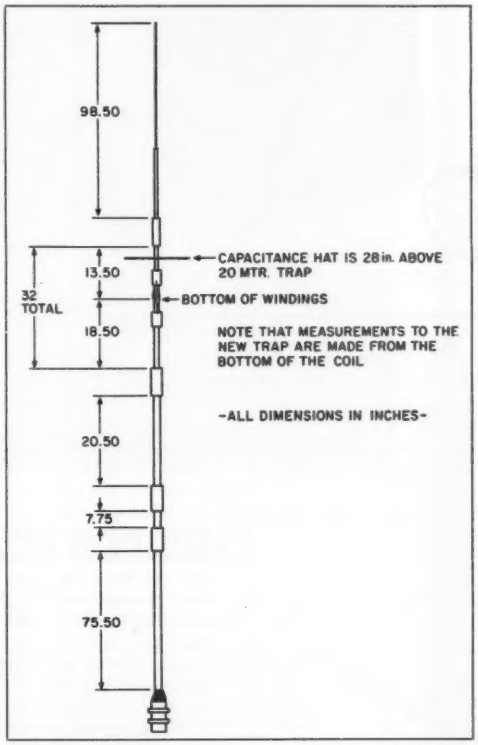

Figure 1. Cushcraft AV-5 trap vertical showing the inserted home-brew 30 meter trap.

A trap for this vertical has to present an impedance of 100–300Ω. For this, you need to know the basic formulas: $X_C = 1/2\pi fC$, and $X_L = 2\pi fL$, where X_C is the capacitive reactance, C is capacitance, X_L is the inductive reactance, L is inductance, and f is frequency. A little work with the calculator revealed that a coil of 3.37 µH and a capacitor of 73.3 pF gives an impedance of 214Ω and resonance at 10.125 MHz.

The exact dimensions of the coil wound on a 1″ wood dowel form are 20.5 turns of wire, "spread wound" to a length of 2.7 inches. A 37″ length of Mini 8 coax provides the proper capacitance. But, the simplest way to resonate the coil is to first wind the coil on the form, solder on a "longer than needed" piece of coax, then carefully snip off the other end of the coax, a little at a time, until you reach resonance.

Construction Details

To build the trap, first get a length of 1″ wood dowel from your local lumber or building supply store. You will also need about 80 inches of #12 solid copper wire, plus two pieces of 1″ i.d. (inside diameter) aluminum or copper tubing, available at a plumbing supplier or hardware store, for covering on the ends of the wood form. Be sure to pick up a couple of hose clamps and some screws. Most instructions recommend coil dope to cover the coil, but I used a product called Varathane™. It is an "all weather" clear plastic finish applied with a brush. It did not change the resonant frequency of the trap at all. You could also use regular vinyl electrical tape to hold the coil windings in place.

See Figure 2. Cut a 9.5″ piece of the wood dowel rod. The 1″ tubing will slide over the ends of the dowel. You will probably have to wrap a layer of thin aluminum or galvanized sheet metal around the ends of the wood dowel as "one inch" means a different thing to a plumber than it does to a carpenter. You could cut a section out of a tin can to provide this material.

Next, put a layer of epoxy glue on the last two inches of each end of the wood dowel. Wrap the appropriate amount of tin around the 2″ end of the wood. Now add another coating of epoxy, then slip the 4″ pieces of tubing onto the ends of the dowel. Slide the tubing on over just the first two inches. Now roll the assembly on a table to insure that it is straight. You may need to wiggle and twist it a little.

After the epoxy has set, drill a hole in each piece of tubing about ½ inch from its inside end. (Later, you'll secure the coil to the tubing at this spot with a screw.) Cut four slots

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into the tubing on the outside ends, about 1.5 inches deep. Measure in about 1.25 inches from the tubing ends (towards the center of the wood form) and drill a small hole for a screw to secure the two ends of the windings. Finally, apply a coat of Varathane or shellac to the wood.

To wind the wire around the wood form, you must first straighten the wire. The wire MUST be entirely kink free! I had to strip the insulation off of the length of #12 wire, but this is fairly easy to do. Clamp one end of the wire in a vise (or tie it around a sturdy fixed object) and slice the insulation for the full length of the wire. The covering will peel off easily. Then, keeping the wire in the vise, use a piece of tubing (the coil form tubing will work for this) to straighten the wire. Holding the tubing in both hands, starting at the secured end of the wire, wind the wire a quarter turn around the tubing, then walk backwards pulling the wire around the tubing with your thumbs. Hold the wire against the tubing so that you get a "drag." You may have to do this a couple of times to get the wire straight, but, if done properly, this procedure really straightens the kinks out of the wire.

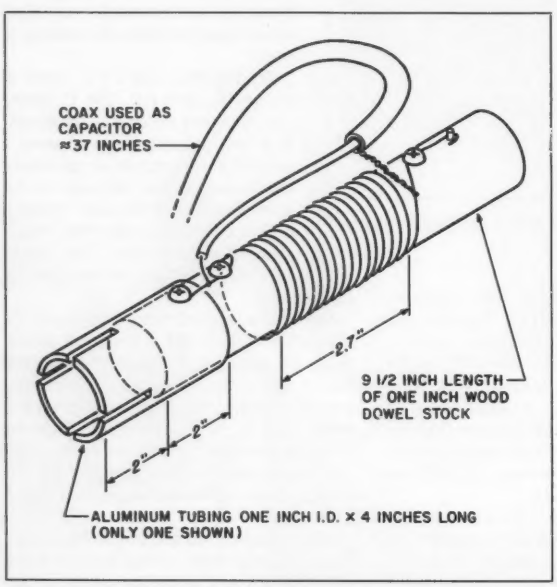

COAX USED AS CAPACITOR ≈37 INCHES
2.7"
9 1/2 INCH LENGTH OF ONE INCH WOOD DOWEL STOCK
2"
2"
ALUMINUM TUBING ONE INCH I.D. × 4 INCHES LONG (ONLY ONE SHOWN)

Figure 2. Details of the 30m trap construction.

Next, secure one end of the straightened wire to one of the inner screws on the wood form. Leave a "tail" long enough to later secure to the screw in the tubing section. Now, with the other end of the wire still attached to a leg of the XYL's china cabinet (or vise), hold the form in both hands, draw the wire taut, and slowly rotate the coil form, winding the wire as you go. You must keep a strong "pull" on the wire to keep the windings tight. Space the windings such that the space in between windings is just slightly less than the diameter of the wire. After 20 revolutions, you should be near the other securing screw. Secure the wire to it. Trim both ends of the wire so that they can be wrapped around and secured to the screws in the tubing, but don't attach them until the trap has been resonated.

Strip off about two inches of the outer insulating jacket of the piece of coax. Slip the inner conductor through the braid so as to have a piece of coax with a 2" inner con ductor lead and a 2" outer conductor lead. Or, just unravel the braid to get the same effect. Now, measure and cut these coax leads so that they can be soldered to the ends of the coil. Slip a piece of insulating material (heat shrink tubing, etc.) over the braid, then solder these leads to the ends of the coil. The trap is now ready to resonate.

Resonating

A grid-dip meter would really be the ticket here, but this poor OM doesn't have one. I used an RF generator connected to a simple RF probe plugged into an analog voltmeter. Connect a small inductor of 10 µH to 100 µH between the RF probe and the RF generator. Tune the generator and you should get a voltage reading on the meter. If not, select the proper voltage setting until you do. Adjust the frequency of the generator to 10.125 MHz with the help of your HF receiver.

Note that, as the generator is tuned higher in frequency, the measured RF voltage will probably decrease. This is because the impedance of the small inductor increases with higher frequency. Don't worry—for our purpose, this is not a problem.

Now place the trap very close to the little inductor (or dip meter). Tune the generator (or dip meter) until you detect a dip in the

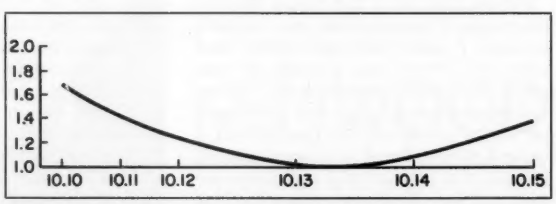
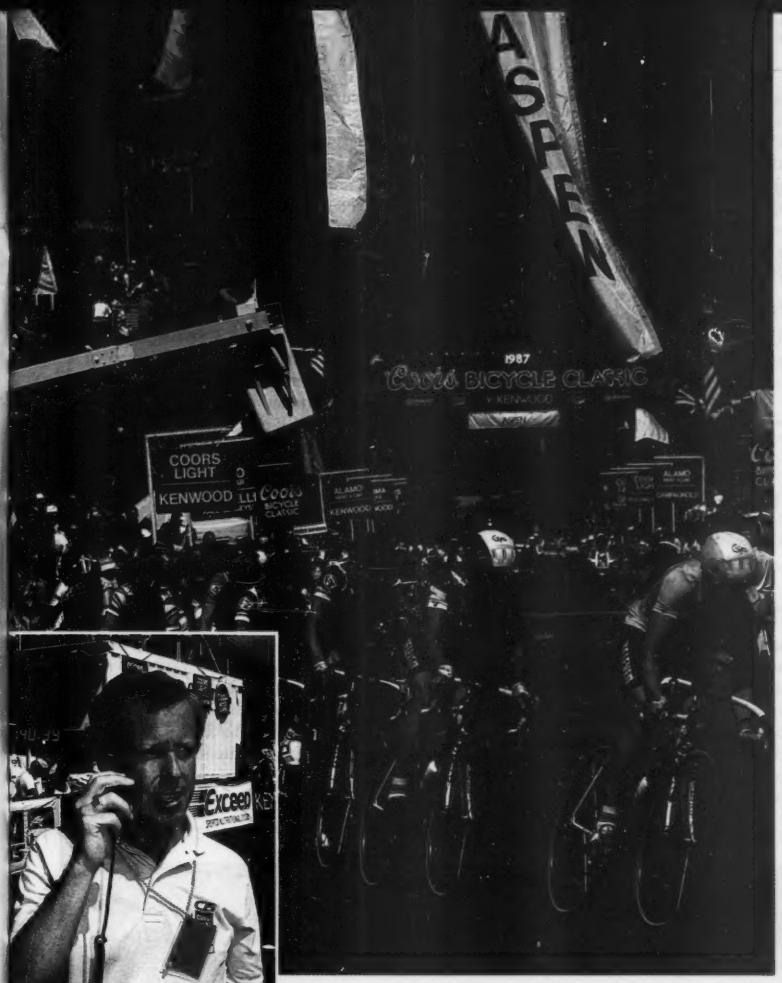


Figure 3. AV-5 SWR curve on 30m after the installation of the 30m trap.



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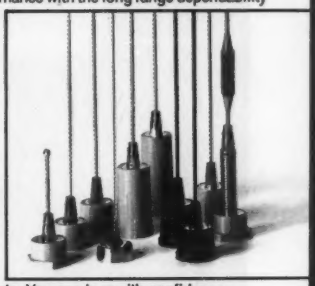

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meter movement. When you find the resonant frequency of the trap, move the trap away from the coil (dip meter) to verify that it is indeed the trap that is causing the dip. If you used Belden Mini 8 coax for the capacitor, the approximate length will be 37 inches. At any rate, start with a length of coax that is a few inches longer. Hopefully, you will have a dip that is lower than 10.125 MHz. Simply snip off small amounts of the coax and remeasure the dip until it occurs at 10.125 MHz.

Also, after finding the preliminary resonance, position the trap as far away from the "dip meter" as possible, while still allowing you to detect the dip. This assures minimum interaction between circuits. If you snip too much coax you can move the coil winding slightly to achieve the same effect (resonance). Remember, though, that the coil windings must not touch each other!

Now you can give the coil windings a coat of coil dope, other suitable varnish, or even plain electrical tape. (It is important that the windings stay put and do not slip.) Attach the coil ends to the tubing. I found that if you don't follow this procedure, resonant frequency will be about 1.4 percent lower, and this is unacceptable.

The next step is to seal the unconnected end of the coax, coil it up three turns or so, and secure it to the trap somewhere above the coil windings. I devised a housing or cover for the coil out of a piece of thinwall 2" PVC tubing and the top half of a round plastic bottle. A little bathtub caulk and tape make a weathertight "rain cap." I then taped the coax to this housing. The coax should be in its approximate position (as opposed to just hanging off the end of the workbench) during the resonating procedure above.

Installing the Trap

Get a length of 1" o.d. (outside diameter) aluminum tubing. Hint: A lot of aluminum lawn chairs use 1" o.d. tubing. (You could use the existing section D tubing of the Cushcraft antenna, but it would be nice to not mutilate it. You might want to sell the antenna at a later date.) Cut two pieces of this tubing to lengths that will let you position the new trap as shown in Figure 1, allowing for some adjustment. Secure the trap with hose clamps. Use the same procedure as described in the antenna's manual for tuning the new trap.

"A trap for this vertical has to present an impedance of 100–300Ω."

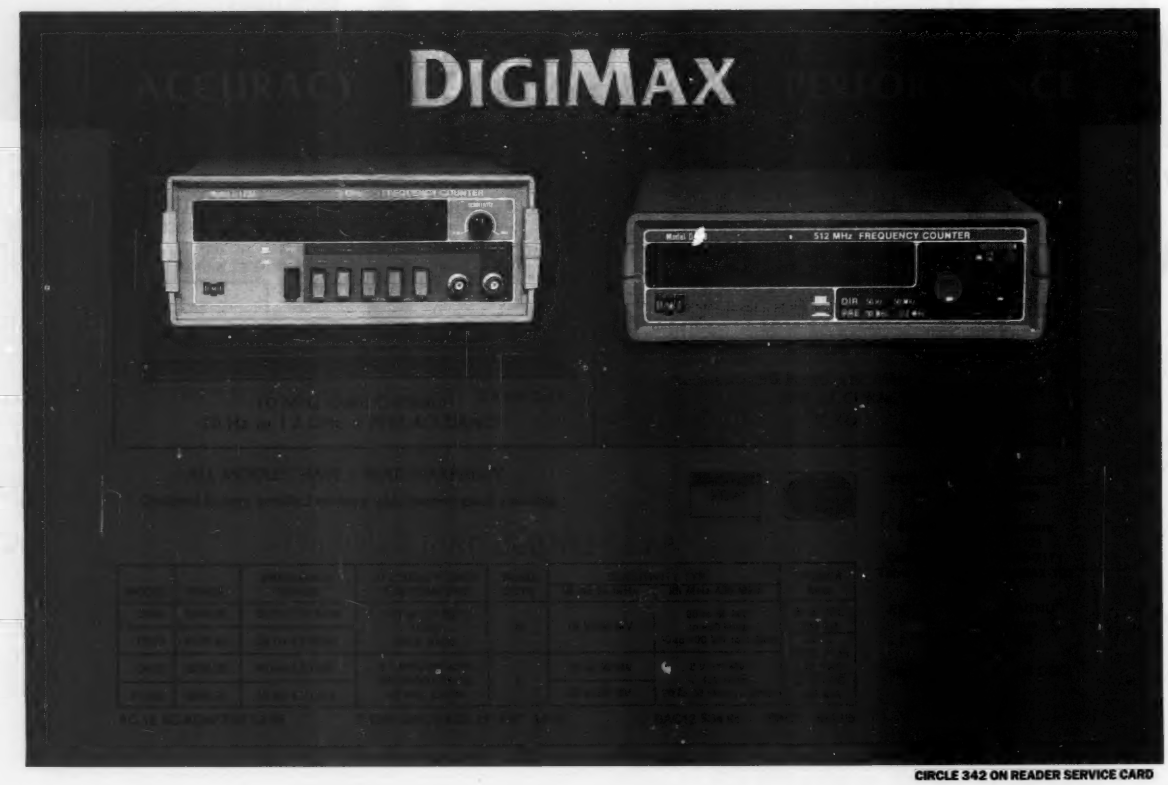
The 10, 15 and 20 meter bands will change little if any. The 40 and 80 meter sections will be shortened slightly, but after you retune them their bandwidths should be just about the same as before installation of the 30 meter trap.

All the dimensions in the figures are for the lowest SWR in the lower parts of the respective bands (CW, RTTY, AMTOR and Packet), but if you want 30 meter capability, you probably are already a CW man or a digital nut like myself. If the trap is resonated and positioned properly, it should produce an SWR of 1:1 at 10.125 MHz, and about 1.5:1 at the band edges. Using the components described, the trap performs perfectly using 100 watts maximum average power.

Final Hints

Construction technique is not critical, but the trap MUST resonate at the correct frequency or you will have a hard time finding a proper position for it in the antenna. (I know: I tried.) Weather-seal the assembly to suit your environment. The measurements for locating the new trap may differ somewhat for the AV-4 antenna, but the trap construction should be the same.

See you on 30m! 73



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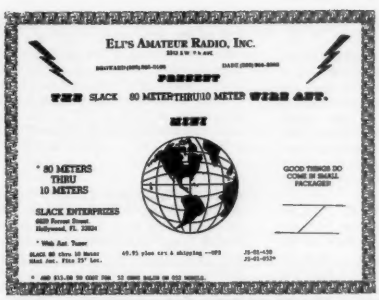
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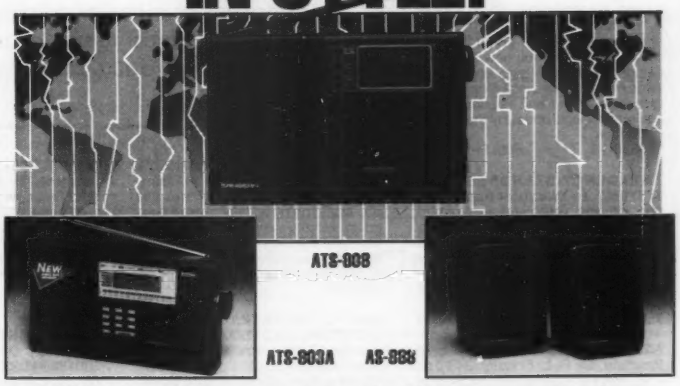

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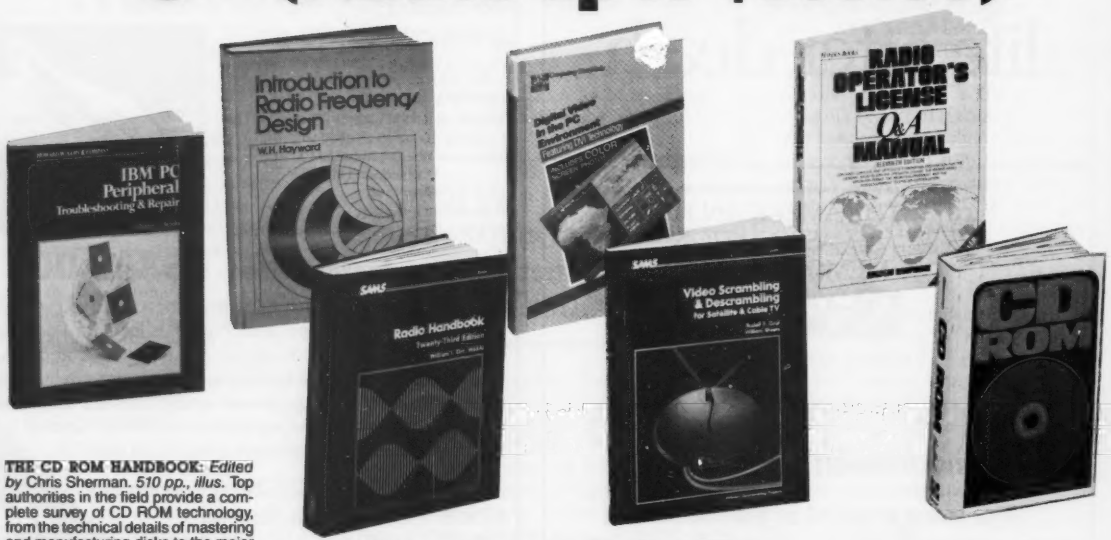
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73 Review *by Paul Grupp KA1LR*

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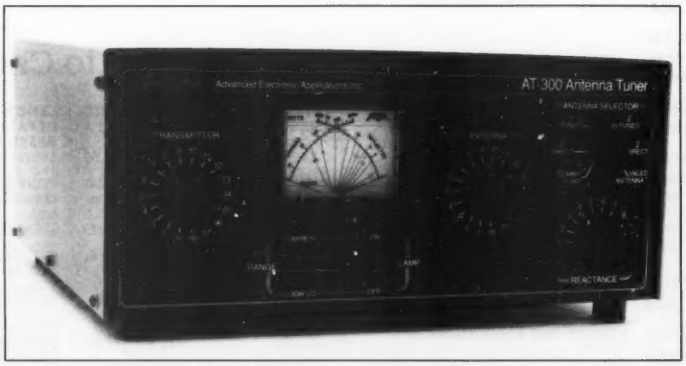
AEA may have built their reputation on digital electronics, but the design and construction of their new AT-300 antenna tuner shows that they've learned a thing or two about the analog world of RF along the way.

The AT-300 includes just about everything we've come to expect in an antenna tuner, with a few unusual twists. On the front panel are TRANSMITTER, ANTENNA, and REACTANCE controls for the tuner. The TRANSMITTER and ANTENNA controls are 18-position switches, and the REACTANCE control is continously variable.



Also on the front panel are a cross-needle SWR/power meter, a 30/300 watt power range switch, a lamp switch for the meter lights, and an antenna selector switch that lets you choose between two coax-fed antennas, a dummy load, and a balanced antenna. The coax-fed antennas have two switch positions each, to place the tuner into, and take out of, the antenna system.

On the rear panel are coax connectors for the transmitter, antennas one and two and dummy load. A post and wing nut are provided for ground, and posts mounted in ceramic insulators are provided for the balanced antenna. 12V power for the front panel lamp can be connected to the 2.1 mm jack.

Inside the AT-300

The AT-300 is housed in a tight RF-proof metal box, with plenty of screws to keep it that way. At 6" x 12.75" x 14.75", it is one of the biggest 300 watt tuners available today, but the size is necessary to keep the Q on the inductors high, thereby reducing loss at the antenna tuner.

Inside, the layout and wiring is neat and efficient. Even though the AT-300 is only rated at 300 watts, its components are as hefty as those found in some tuners rated at over a kilowatt. This provides an extra margin of safety when operating into a severely mismatched load.

The design of the AT-300 is simple. It uses a lowpass T-network, with two multitapped air-wound inductors and a big variable capacitor. This design, while hardly unique, is a departure from most other tuners on the market, which generally use a pi-network configuration. However, the T-network is a reasonable choice; it provides good harmonic suppression, and since two of the three controls are stepped switches, settings are easily repeatable for fast band changes.

"It uses a lowpass T-network, with two multitapped air-wound inductors and a big variable capacitor."

Like most tuners, the network is unbalanced. However, a large ferrite-core transformer is included inside the box for feeding balanced-line antennas.

Some hams might prefer to see roller inductors in place of the switched multitapped inductors found in the AT-300. However, in practice, the 18 position switches provided ample range of adjustment.

The AT-300 in Action

I used the AT-300 with a balanced long-wire antenna for a couple of weeks, and uncovered no problems or deficiencies. I was pleased to discover that the AT-300's meter gave very similar readings to the built-in meter in my Kenwood TS-940S over a variety of power ranges and on all bands. The meters in many tuners are marginal at best, but if you own an AT-300, there is no good reason to buy another SWR/power meter.

The owner's manual is excellent, and provides lots of applications information to keep inexperienced tuner users out of trouble. A schematic is also included with the tuner, in case you ever need to repair or modify it on your own.

My only complaint is that the tuning range is limited to 3.5 to 30 MHz. They didn't include 160 meters.

Conclusions

The AT-300 enters an already crowded field of competitors; good tuners are available from several manufacturers. Nevertheless, the AT-300's features and quality make it worthy of serious consideration for any amateur who doesn't own (anddoesn't plan to own) an amplifier. Its built-in antenna switching, easy-to-read SWR meter, and balanced antenna capabilities combine to make a very useful package. Now, if we can just get AEA to build a larger version for those of us who do run higher power!

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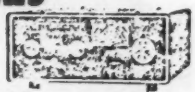

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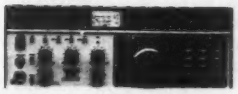

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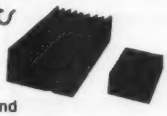

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Unique 12 and 17 Meter Dual-Band Beam

Build a high gain beam for these two new WARC bands.

by Robert F. Bloom W6YUY

Have you noticed that there are many monoband beam articles published, but almost none for multi-banders, even for the non-WARC bands? There's the feeling that hamdom has no choice but to buy a multiband beam. I figured, though, that for $500 dollars and up for the commercial products of comparable quality and gain, you could build a multibander for up to a quarter of the price, and learn a lot in the bargain!

This article shows you how to do this. The antenna project here is a unique 12 and 17 meter interspaced dual-band array. This puts you on two great bands. 17 meters has the best of both worlds (so far)—it has propagation characteristics very similar to that most popular DX band, 20 meters, and yet is still only very moderately used. 12 meters is also a very mildly used band, and is open at least as often as 10 meters—which is quite often these days.

Impressive Specs

The forward gain of this beam approaches 8 dBd and has a front-to-back ratio of 25 dB. The single radiator element uses a pair of 12 meter high-"Q" traps and a pair of stacked gamma matching units which accommodate a single 50Ω coaxial cable transmission line. Construction is simple and sturdy.

I suggest this beam for a club project not only because of its fine performance, but also because you save money when you buy aluminum tubing in quantity. A source for the tubing is *Metal & Cable Corporation, 2170 East Aurora Road, POB 117, Twinsburg OH 44087.*

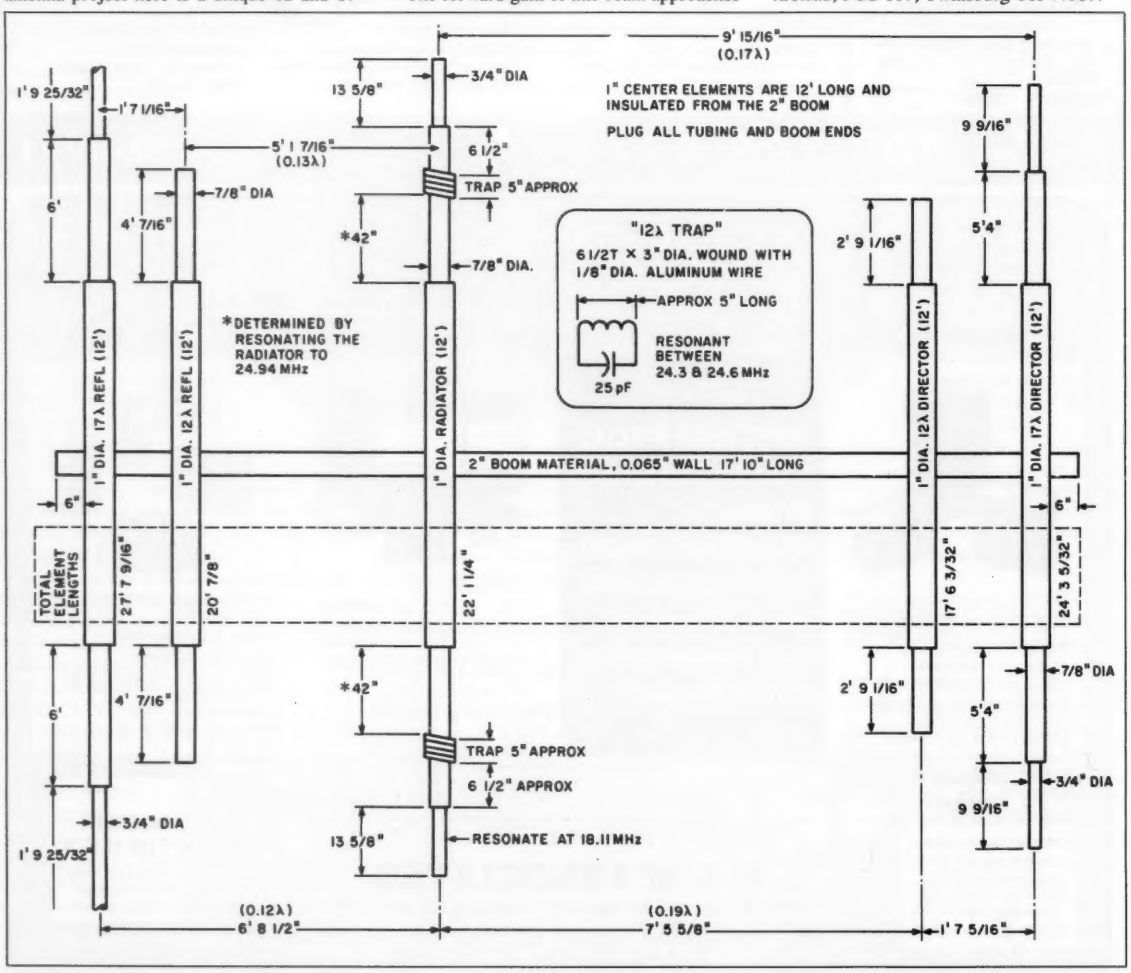

Figure 1. Plan with dimensions for the dual-band 17 and 12 meter beam antenna.

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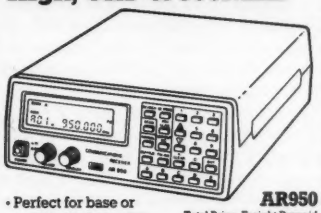

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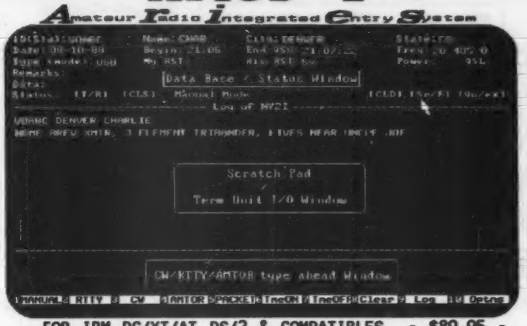

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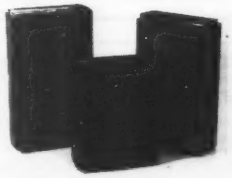

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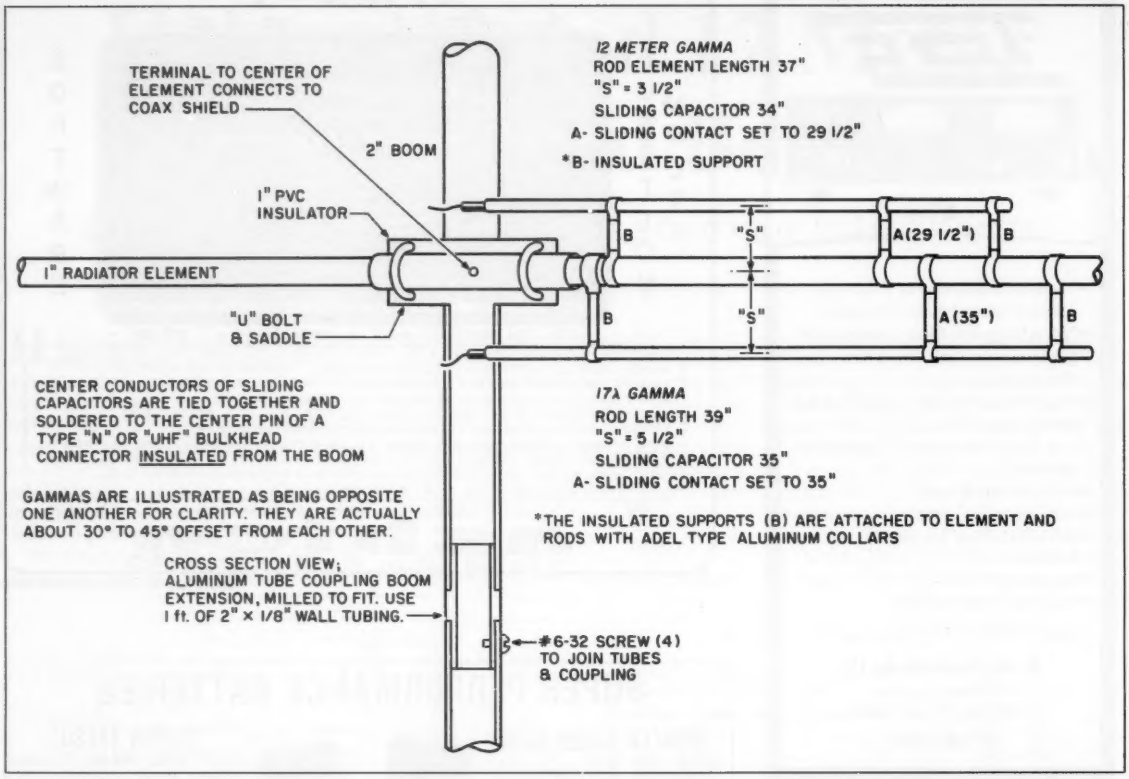
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"U" BOLT & SADDLE
12 METER GAMMA
ROD ELEMENT LENGTH 37"
"S" = 3 1/2"
SLIDING CAPACITOR 34"
A- SLIDING CONTACT SET TO 29 1/2"
*B- INSULATED SUPPORT
B
"S"
A(29 1/2")
B
B
"S"
A(35")
B
CENTER CONDUCTORS OF SLIDING CAPACITORS ARE TIED TOGETHER AND SOLDERED TO THE CENTER PIN OF A TYPE "N" OR "UHF" BULKHEAD CONNECTOR INSULATED FROM THE BOOM
GAMMAS ARE ILLUSTRATED AS BEING OPPOSITE ONE ANOTHER FOR CLARITY. THEY ARE ACTUALLY ABOUT 30° TO 45° OFFSET FROM EACH OTHER.
17λ GAMMA
ROD LENGTH 39"
"S" = 5 1/2"
SLIDING CAPACITOR 35"
A- SLIDING CONTACT SET TO 35"
*THE INSULATED SUPPORTS (B) ARE ATTACHED TO ELEMENT AND RODS WITH ADEL TYPE ALUMINUM COLLARS
CROSS SECTION VIEW; ALUMINUM TUBE COUPLING BOOM EXTENSION, MILLED TO FIT. USE 1 ft. OF 2" × 1/8" WALL TUBING.
#6-32 SCREW (4) TO JOIN TUBES & COUPLING

Figure 2. Stacked gamma matching devices.

This unit has a boom length of 17 feet plus, and is actually equivalent to a new commercial product with a boom length of 19 feet. You may wonder how it's possible for an array to perform as well as one with a longer boom length. The element spacing is similar to that of the 19 footer, but the trick here is that I use only a single radiator for the two bands; the 19-footer uses two, one for each band. The second radiator has to be separated from the other element, which demands more boom space without adding an iota of gain.

Parallel Gamma Matches

Feeding a beam with multiple gamma matches is not new, but little has been written on the subject. I found mention of them only in *The New Beam Antenna Handbook*, by William Orr W6SAI and Stuart Cowan W2LX. This book is one of the best ham antenna publications available.

If you follow my dimensions on both the beam and trap construction, and make the initial SWR adjustments to the radiator, forward gain will be within 0.5 dB of optimum. Any changes, such as increasing the diameter of element tubing, will change the taper factor and require lengthening of these elements.

About Gain Figures

According to feasibility charts for a 3-element array, obtained from the *New Beam Antenna Handbook* mentioned above, the maximum forward gain possible at a given frequency and optimum boom spacing (0.45λ) is 7.8 dBd. An ad for a particular antenna manufacturer, however, states that their beam with the same configuration has 8.5 dBd gain! Since it has been shown in the past, however, that gains stated in ads are usually not rigorously verified (which in fact led several magazine to refuse to run ads for antennas with gain figures), don't hope for more than 8 dBd out of this configuration. Still, that's a hefty figure!

Front-to-back ratio is the most difficult of the two main characteristics of a beam to pin a value on. With the presence of earth ground, the ratio depends on the angle of the signal arriving at the rear of the array. It will vary widely between a low and high angle signal. Nonetheless, feasibility studies show that a typical F-to-B for this configuration is 25 dB.

Effects of Traps

The physical length of the trap coil and its inductance determine both the length of the inside element (that part of the radiator element in front of the trap) and the length of the lower frequency element beyond the trap. Essentially, the hat capacity of the trap shortens the inner length, and the coil inductance shortens the lower frequency stub dimension.

Figure 1 provides all of the element dimensions. All element material other than the boom has a wall thickness of 0.058". This is the only size that will allow telescoping of elements and clearance of several thousandths of an inch. The boom wall thickness is 0.065".

The center section of each parasitic element is a 12' length of 1" outer diameter (O.D.) tubing. A ⅞" O.D. material telescopes therein, and where necessary for an additional taper, use a ¾" O.D. material. The best aluminum tubing is 6061-T-6 (61S-T6) and comes in 12-foot lengths. You can also use Type 6063 T-8, sometimes used by manufacturers, though it is softer, and bends and fatigues more easily. The unreinforced 27' plus 17 meter reflector bows a bit on the beam; you can insert a 10½' section of ⅞" material inside the 1" center segment to double the wall thickness.

When determining the length of telescoping elements, be sure to allow 5" to 8" for the telescoping segment that holds the element in place. Cross-slot the ends of all element sections away from the boom, where telescoping will be required. To do this, use a hack saw to cut slots of 1¼" to 1½" and deburr with a fine tooth file. Slotting allows a good quality aircraft type hose clamp to bind the material securely.

I suggest coating all telescoping segments with an oxidation inhibitor, such as No Ox™, Ox-guard™, Cual-aid™, or Penetrox™. These trade names are available through electrical supply houses. Without this, you won't be able to slide the telescoped sections after a few months. If your climate is antenna-hostile, with rain, sleet, snow, and especially high salt content in the air, seal the door knob capacitor ends with plumber's white silicone sealant and position them beneath the element when you erect the antenna.

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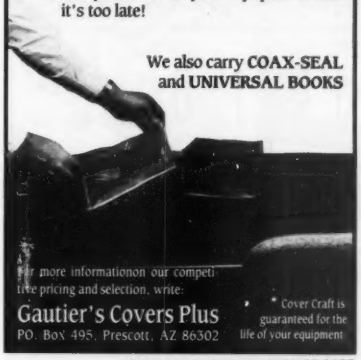

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Gamma Matching Units

Figure 2 shows the gamma match dimensions. These are made of ½" O.D. tubing. A means for tuning out the inductive reactance of the gamma element must be provided. Salvage the dielectric and center conductor portion from sections of ½" coaxial cable: RG-8, RG-9, RG-11, RG-13, or equivalent. When telescoped into the ½" gamma element, this becomes a variable capacitor. The telescoping fit is rather loose, but tuning is broad enough for a stable value. Rule of thumb normally calls for approximately 7 pF per wavelength, but in this case 5 pF per λ works better. Use the length as shown in Figure 2 and follow all dimensions.

The center conductors of both sliding capacitors are tied together and connected to the center pin type "N" or UHF bulkhead connector. The connector is mounted close to the gamma feedpoint. The shell or shield side of the bulkhead connector is insulated from the boom. I used a 1/16" thick piece of Teflon™ for insulation and held the bulkhead assembly to the boom with a large hose clamp.

How do stacked gammas interact with one another? I found that with only one gamma in the circuit at a time, the tuned positions did not exactly coincide, as they did when both were in the circuit. I attribute this to a shift in the impedance point on the radiator due to loading by the additional gamma. But once the proper point has been established, the two units do not see each other due to their high "Q" at their respective frequencies. Electrically, only one is effectively in the circuit at a time.

Insulating Elements from the Boom

All five elements are insulated from the boom to prevent any reaction from boom resonance, if present, and to preserve a good front-to-back ratio. 10" or 11" sections of 1" schedule 40 PVC pipe slides over the 1" center elements. There are two ways to secure the PVC's rather loose fit. You can seal the PVC with a layer of plumber's white silicone sealant or by drilling a ¼" hole in the center of the PVC; then drilling and tapping an 8/32 hole at the 6' point of the element sections, lining up the holes of the PVC and the element. I prefer the latter method because the ¼" hole in the PVC not only simplifies alignment, but recesses the head of the screw. After securing the element with U-bolt and saddles, tighten the nuts to compress the PVC to the tubing.

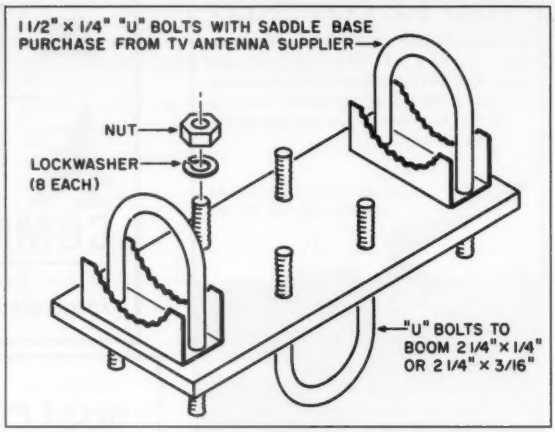

Figure 3. Parasitic and radiator element mounting plate.

Making the Trap Coils

Trap coils have disadvantages: they complicate determination of the length of the parasitic elements; increase gain loss due to the reduced element length; and add to construction problems. They're often a necessary evil, however, when designing a multiband beam.

I made the two 12 meter radiator traps with ⅛" aluminum wire. You can find this wire in well-stocked hardware stores or electrical supply houses. Buy the insulated type if possible.

My coils have a green transparent plastic insulation which stripped off the ends quite easily. The cost for 50' was under $6, and it'd be even less from an electrical supplier. You will need about six feet per coil. The coil requires 6½ turns of 3" diameter. Allow 2" to 2½" at the end of each coil so that it can be mounted centrally and have about ¾" in contact with the element.

Aircraft hose clamps hold the coil in place. Use the shaft of a ½" drill or other tool to initially space the coil turns. A 25 pF 5000 volt doorknob high-Q transmitting capacitor (or a pair of 50 pF in series) shunt and mount inside the coil. The capacitors are connected to lugs that contact the elements. The traps are made resonant between 24.3 and 24.6 MHz. The object is to present a very high reactance to the lower frequency element stub beyond the trap.

The insulating material for the traps is made of two 4¾" lengths of ¾" O.D. schedule 40 PVC pipe. Chuck about 2" of the material into a bench vise and cut two 9" lengths of ¾" element tubing. These will become the outer conductors of the traps.

The inside diameter of the ¾" PVC is too small to accommodate the ¾" aluminum tubing. Prepare the inside by either reaming or filing a small amount to help start insertion of the aluminum tube. Carefully heat the PVC end with a small propane torch. Keep moving the flame to prevent scorching the PVC. The material will soon become soft and pliable. Force about 2" of the 9" length of tubing into one end of the PVC, keeping the alignment straight.

To gain confidence, experiment a little with a sample piece. After completing the procedure for the short ends, do the other end of the coil. This time the length of ¾" tubing is 4¼ feet. This will become the 12 meter section that telescopes into the 1" diameter center section element.

When you're finished, clean up any burnt spots with a file or sandpaper. Drill a 6/32 tapped hole near the ends of the PVC about ½" to ¾". Drill clean through both the PVC and aluminum tubing to the opposite side. Tap the hole on both sides and use 1¼" long 6/32 screws. Slide a soldering lug, a 5/16" flat washer, onto the screw and screw it into the tapped hole and out the end. Secure using a flat washer, star washer, and nut. Repeat on the opposite end of the PVC.

CAUTION: Be sure to allow a proper distance between the lugs to accept the 25 pF capacitor. These screws and lugs become the connection for the capacitor to the 12 meter and 17 meter element sections as well as shunting the coil. Repeat the procedure for the second trap.

Perform the final grid dipping when the coils are in place on the antenna assembly. Dip for a frequency between 24.3 or 24.6

Parts List

Item	Tubing	Price/Ft.	Subtotal
1.	12', 1/2" O.D. x 0.058" Wall	0.73	$ 8.96
2.	12', 3/4 O.D. x 0.058 Wall	1.02	12.24
3.	60', 7/8 O.D. x 0.058 Wall	1.10	66.00
4.	60', 1" O.D. x 0.058 Wall	1.16	69.60
5.	24', 2" O.D. x 0.065 Wall "Boom"	2.79	66.96
6.	1 sheet 27½" x 10" x ⅛" 3½ lbs.	2.50/lb.	8.75
7.	50', ⅛" aluminum wire	5.75	
8.	14 ea. 2¼" x 5" x 5/16" U-Bolts	0.65 ea.	9.10
9.	10 ea. 1¼" x 3" x ¼" U-Bolts/Saddles	0.65 ea.	6.50
10.	1 ea. 8 oz. Tube, Oxguard/Oxidization/Inhibitor	4.79	4.79
Total			$258.65

The above total is near the *maximum* figure you would pay if you bought all the materials in single units. With salvaging and quantity orders, expect that figure to drop by as much as one half.

Note that in item 5, I used less than 18'. Item 7 required only 11'. This list doesn't include end caps, Adel collar clips, plumber's sealant, or sales tax. Also, about 1' of 2" x 0.225 wall aluminum tube must be milled to couple two pieces of boom material.

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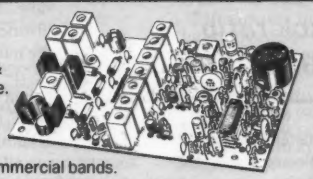
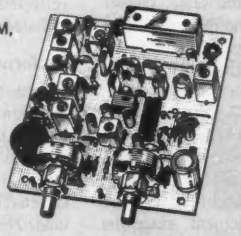


- **FM EXCITERS:** Kits $99, W/t $179. 2W continuous duty. TCXO & xtal oven options available.
- **TA51 for 10M, 6M, 2M, 150-174, 220 MHz.**
- **TA451 for uhf.**

FCC type accepted for commercial bands.

- Call for latest information on 900 MHz transmitters.
- **VHF & UHF AMPLIFIERS.** For FM, SSB, ATV. Output from 10 to 50 Watts. Several models, kits starting at $79.



- **R144/R220 FM RECEIVERS** for 2M, 150-174, or 220 MHz. **GaAs FET** front end, 0.12uV sensitivity! Both crystal & ceramic filters plus helical resonator front end for exceptional selectivity: > 100dB at ±12kHz (best available anywhere)! Flutter-proof squelch. AFC tracks drifting transmitters. Kit $149, w/t $229.
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at a fraction of the cost of comparable units!

LNG -(*)

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ONLY $59! Wired/tested

FEATURES:

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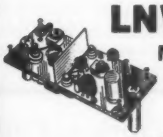
- **Stable:** new-type dual-gate GaAs FET

** Specify tuning range desired: 26-30, 46-56, 137-150, 150-172, 210-230, 400-470, or 800-960 MHz.*

LNW -(*)

MINIATURE GaAs FET PREAMP



ONLY $24/kit, $39 Wired/tested

GaAs FET Preamp similar to LNG, except designed for **low cost & small size.** Only 5/8"W x 1-5/8"L x 3/4"H. Easily mounts in many radios.

** Specify tuning range desired: 25-35, 35-55, 55-90, 90-120, 120-150, 150-200, 200-270, or 400-500 MHz.*

LNS-(*)

IN-LINE PREAMP

ONLY $79/kit, $99 Wired/tested

GaAs FET Preamp with features similar to LNG series, except **automatically switches out of line during transmit.** Use with base or mobile transceivers up to 25W.

**Specify tuning range desired: 120-175, 200-240, or 400-500 MHz.*

HELICAL RESONATOR PREAMPS

Low-noise preamps with helical resonators **reduce intermod & cross-band** interference in critical applications.

MODEL HRA-(*), $49 vhf, $84 uhf.

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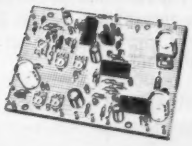

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RECEIVING CONVERTERS

		Antenna Input Range	Receiver Output
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		50-52	28-30
		50-54	144-148
VHF		136-138	28-30
MODELS		144-148	28-30
Kit with Case	$59	146-147	28-30
Kit less Case	$39	146-148	28-30
Wired w/case	$89	220-222	28-30
		220-224	50-54
		222-224	28-30
UHF MODELS		432-434	28-30
Kit with Case	$69	435-437	28-30
Kit less Case	$49	432-436	144-148
Wired w/case	$99	432-436	50-54
		439.25	61.25
		902-928	422-448
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MHz. If the frequency is too low, the coil will need stretching (wider spacing between turns). You can adjust the coil length by repositioning the coil hose clamps. If the frequency is too high, you may have to squeeze the turns closer together.

Element to Boom Brackets

Figure 3 shows the bracket for holding the radiator and parasitic elements to the boom. This is made from ⅛″ thick aluminum plate. The narrow dimension is 3¼″ (if you use material 3/16″ thick, you can reduce this to 3″) and length is 9″ to 10″. The U-bolt should be ¼″ to 5/16″ in diameter, and have a saddle for seating the elements.

The U-bolts to the boom should also have saddles. These may be more difficult to find, but I would start looking for them at auto muffler shops. Check also in electrical and plumbing supply houses. You can use U-bolts without saddles on the boom, but they shift out of alignment after a time. If you can't find U-bolts with saddles, then drill, after aligning them, an 8/32″ or 10/32″ tapped hole through the element plate and boom and secure them with a short screw.

When assembly is completed, find a relatively clear area and mount the antenna between two wooden ladders. This is easier if your boom length extends 6″ beyond the elements at either end. To block the assembly up, place short lengths of 2″ x 4″s on edge under the element support plate. With the boom 5′ above ground, you have easy access for the initial tuning.

Initial Tuning and Settings

Prepare a 3–5 foot length of small diameter 50Ω cable (RG-58 or equivalent). Put a coax connector on one end to mate with the one on the array, and make a 3″ loop at the other end (center conductor to shield) to couple with the coil of a grid dip test instrument. Disconnect the sliding connectors of the gammas. Coupling between the gamma element and the radiator should be sufficient for measuring the radiator resonance.

Starting with 12 meters, look for a dip near 24.9 MHz. There may be a number of dips over a wide frequency range, but concentrate on those of concern. When you locate one near the frequency, verify it by touching the coil or the radiator element ahead of the coil. The frequency dip will shift or disappear. By adjusting the length of the 12 meter telescoping section (that portion of the element ahead of the trap), you should be able to set the resonant frequency to 24.94 MHz. Touching the stub element beyond the trap should not disturb the dip, indicating that the trap is performing properly. Mark the point of insertion of the 12 meter element with pencil or paper tape. If you have not located a dip by now, you may have to connect the sliding contact of the gamma. But, using this system, I had no problem locating any of the dips. Adjust both left and right sections of the dipole to the same dimensions.

Now, locate the 17 meter radiator resonance. Once you find it, adjust the 17 meter stub for a frequency of 18.11 MHz. The stub will be very sensitive as to position.

Loading and Adjusting the Beam

The unit is now ready for an RF energy test. You will need a Bird Model 43 or equivalent, and a 1 or 5 watt Bird slug element (the directional coupler element). Connect both gamma sliding contacts to the approximate dimensional positions.

Before continuing, remember that you are in the RF field of the radiated energy. Low power (below ten watts) is fine, but be careful to not pump much more RF than that into the beam while working near it, especially while standing in the beam path. Only you are responsible for taking the necessary precautions here!

Begin by applying 1 or 5 watts, depending on the full scale rating of the wattmeter element at a frequency of 24.94 MHz. Reverse the direction of the Bird slug element. The meter now indicates the magnitude of the reflected energy. Move yourself out of the field of the radiator, and observe the meter indication. Adjust the 12 meter gamma sliding contact to reduce the reflected power indication, thus reducing the SWR.

"The forward gain of this beam approaches 8 dBd and has a front-to-back ratio of 25 dB."

You may achieve further reduction by making a small adjustment in the length of the 12 meter element section. Adjust both sides of the element equally. With this minimized to a small percentage of the scale, change frequency to 18.11 MHz and re-establish the power setting. Adjust the gamma slide contact on the 17 meter gamma for minimum reflected indication. Further adjustment is made by positioning the 17 meter stub element beyond the trap. The end section adjustment is very sensitive to length and the proximity of your body. Adjust for minimum indication. Halve the perceived change length needed for each element, since the other end of the element must also be adjusted by the same amount, to maintain dipole length symmetry. For example, should you find a change of ½″ is required, then change it by ¼″ on the first element end, and then go to the other end of the dipole and set the length by the same amount (to total ½″) so that the stub lengths are equal. Keep repeating these adjustments until you achieve unity or minimum SWR.

Be sure to adjust for 12 meters first, since these adjustments affect the 17 meter element/gamma match tunings. When completed, reposition the array. Set the reflector end on the ground and prop the director end up in the air 45 to 70 degrees and in the clear. For this, I suggest using a 6-foot length of 2″ x 4″. Notch out one end so that it will cradle the 2″ boom material at a point behind the 12 meter director. Using C-clamps, attach the 2″ x 4″ to the side of a six-foot ladder. Position the ladder so that it supports the boom with the antenna facing upwards and away from any nearby obstacles, like trees or buildings.

Once again, check for minimum reflection indication. And touch up on gamma slide contact position and element lengths. Start with 12 meters and conclude with 17 meters. At this point, expect little change.

Further tuning depends on the type of your tower and its location. It's best to final-tune the antenna at operational height, though this is impossible most of the time.

If the tower is crank-up or tilt, so much the better. First lower it to minimum height. If there is a sturdy nearby structure, stand on it to insert the sliding elements, having marked the position of and removed these elements before mounting the boom to the mast. When the sliders are out, there is only 6 feet of element on each side of the boom. Still, erection is a two-person job.

Insert the telescoping elements after the antenna is in place on the tower. I was able to position my antenna at 15 or so feet, and make finite element adjustments at that height. Very little adjustment was necessary. At worse, if no further adjustment is physically possible, the most you'd lose in gain would be ½–¾ dB. With my array at full height (45 feet), I have unity SWR on 17 meters and and a maximum of 1.3:1 on 12 meters. My 940S automatic antenna tuner allows me to obtain a perfect conjugate match of the entire system on both bands. A conjugate match keeps all the system currents in phase. With frequencies in the HF spectrum and ½″ variety transmission line, there will essentially be no loss, and any reflected energy on the line will eventually be radiated.

Performance

With 100 watts into the transmission line, my signals on either band are consistently among the stronger on the band. Minutes after erecting the dual band beam, I got on the air, and immediately worked IK6BAK in Cesena, Italy, on 12 m, and ZL1PD, in Auckland, New Zealand, on 17 meters. Both answered immediately on my initial abbreviated call during a pile-up, and gave me a resounding 5-9+ report. From my QTH, you just can't get much further away than Auckland! And that was just the beginning of many long and rewarding DX QSOs on these two new WARC bands with the dual-bander.

I hope you have as much fun as I did building and using this beam! Let me hear from you. An SASE is sure to get a reply. 73

Robert E. Bloom W6YUY has worked in many phases of radiocommunications engineering, including broadcasting, antenna design, and tower structure design. He has had his ticket since the early thirties. Bob can be reached at 8622 Rubio Ave., Sepulveda CA 91343.

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You get a versatile 6-position antenna switch and a 4:1 balun for balanced lines.

You can run up to 300 watts PEP and tune out SWR on coax, balanced lines or random wires.

Unconditional Guarantee

You get a *full one year unconditional guarantee.* That means we will repair or replace your MFJ tuner (at our option) *no matter what* for a full year.

Others give you a 90 day *limited* warranty. What do you do *after* 90 days? Or *before* 90 days when they say, "Sorry, it's your fault"?

What's really important? *precise* control for minimum SWR

What's really important is your tuner's ability to get your SWR down to a minimum -- and the MFJ-949D gives you more precise control over SWR than *any* tuner that uses two tapped inductors.

Why? Because the two *continuously* variable capacitors in the MFJ-949D give you *infinitely* more positions than the *limited* number on two switched coils.

This gives you the precise control you need to get minimum SWR and maximum power into your antenna.

After all, isn't that why you need a tuner?

High efficiency *and* a compact size: *performance* is most important

The MFJ-949D uses a *single* airwound coil. Using only one inductor takes up a minimum of space and there's no mutual coupling problems.

The excellent form factor of the short fat coil gives you highest Q. Plus you get plenty of inductance that gives you a much wider matching range than other designs.

This results in a highly efficient tuner that puts maximum power into your antenna *and* a compact 10 x 3 x 7 inch size that complements your rig and fits right into your station.

Competing tuners using *two* tapped coils *require* a large cabinet -- not just to house the coils but also to help reduce detrimental coupling between the inductors. The result? *A tuner that's* ***bigger*** *than your radio.*

Your very best value

The MFJ-949D gives you your very best value, first-rate performance, proven reliability and the best guarantee in ham radio . . . all from the *most trusted* name in antenna tuners. Don't settle for less. Get yours today!

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For a *few* extra dollars the MFJ-962C lets you use your barefoot rig now and have the capacity to add a 1.5 KW PEP linear amplifier later. It covers 1.8 to 30 MHz.

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Kaboom Micro Keyer

Iambic keyer in the palm of your hand!

by Michael Jay Geier KB1UM

Sure, most of us use VHF, but have you ever thought about operating HF mobile? You might be surprised at how many hams run HF rigs in their cars. Of course, they only use SSB, right? Wrong! Many hams use other modes, such as CW and RTTY, and why not? While I don't recommend running RTTY while driving (though it's fine if you're just a passenger), you can use CW without causing dangerous driver distraction. And its weak-signal capabilities make it especially suited to mobile operation, where fading signals and high noise levels sometimes obscure other modes.

The bug hit me while I was on a long trip with my TS-120S blaring away on SSB. I decided to do a little CW listening to pass the time, and found it no trouble to copy in my head as I drove. So, I thought, why not send as well?

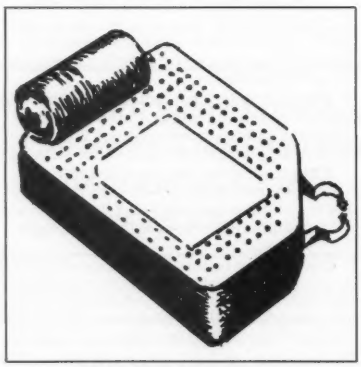
Searching for the Key

Certainly, I'd heard of mobile CW operation. In fact, there were mobile ops when CW was the only mode! Obviously, I'd have to work out some sort of key arrangement which would be safe (absolutely the prime consideration!), comfortable, and convenient.

A straight key was out. The bumping and jarring of my compact car made the manual generation of dits and dahs impossible. Some sort of keyer seemed like a good idea, and I like iambic keyers, anyway. I tried using my Bencher paddle on the seat, but that required my arm to be placed in an uncomfortable and fatiguing position, and the paddle wobbled around too much on the upholstery. Finally, I decided to use the ol' ham spirit and build a keyer optimized for the intended use.

Easy Circuit

Fortunately, a simple keyer doesn't require much circuitry these days, thanks to the amazing Curtis 8044 series of ICs. One of these chips provides most of the guts, and only a few other components are required. 8044 CMOS iambic keyer chips are available from *Curtis Electro Devices, Inc., Box 4090, Mountain View CA 94040. Tel. (415) 964-3846.*



The Kaboom Micro Keyer.

See the figure for the circuit of the Micro Keyer. I chose an open-collector transistor output, which keys my Kenwood with no difficulty. Some rigs, such as certain ICOMs, require a very low impedance contact closure, and thus won't key properly with a bipolar transistor. A power FET will usually do the job.

"Fortunately, a simple keyer doesn't require much circuitry these days . . ."

Whence Paddles?

OK, so the circuit was easy. What about paddles? I wanted the entire unit to fit into my hand, so the paddles had to be much smaller than any of those commercially available. A search of the junk box yielded two microswitches, each with a lever arm. Placing them at right angles revealed that they could indeed function as paddles. They click, but the sound is barely audible in the noise of the car. In fact, the feel of the switches clicking provides nice tactile feedback.

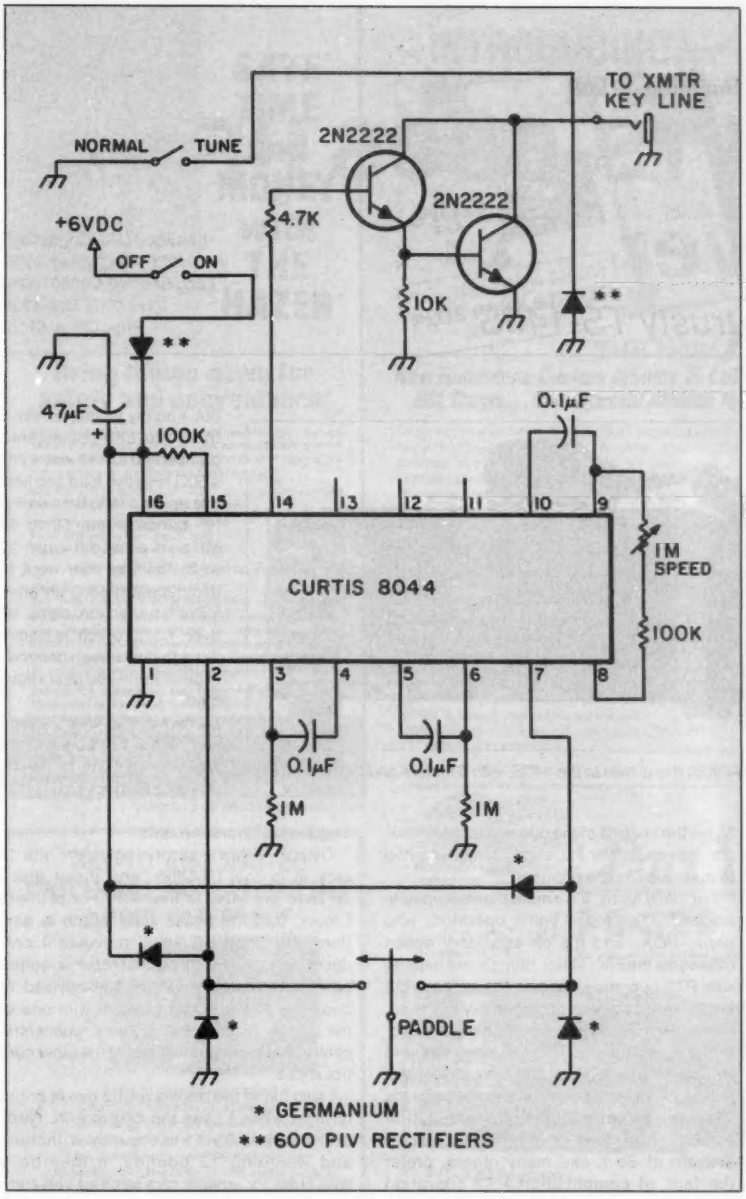
Et Voilà!

The photo shows the completed unit. The paddles protrude from the forward right corner, which allows you to place the microswitches in the most space-efficient configuration. It also permits you to operate them with the thumb and index finger when the unit is held in the palm. As a bonus, you can also use the keyer with it lying flat on a table.

I put the circuit together in one afternoon, using point-to-point wiring on perfboard. Any type of construction will do, but this technique lets you cram the parts close together. Output is through a standard earphone-type mini-jack. Two DIP switches on the back turn the keyer on and off, and short the output so you can tune your rig with a continuous carrier.

The case is made of more perfboard, held together with hot melt glue. Those of you with good mechanical construction skills can certainly do better. Two wires, glued so that they limit the travel of the microswitches' arms, are bent so that the arms rest very close to the switching point, making for tight, fast paddle action. The trimpot for the keyer speed is adjusted with a screwdriver, through a small hole in the case top.

The battery, soldered in and glued on top, is a 6-volt Energizer purchased at Radio Shack. It's much smaller than the usual 9-volt square type. Omitting the battery holder keeps the size to a minimum. The keyer eats so little current that I am still on my first battery after two years of (admittedly infrequent) operation! Be careful not to overheat the battery when soldering, or you will ruin it. If you intend to use the keyer very often, or



The circuit for the Kaboom Micro Keyer.

you don't care to solder to the battery, use a holder.

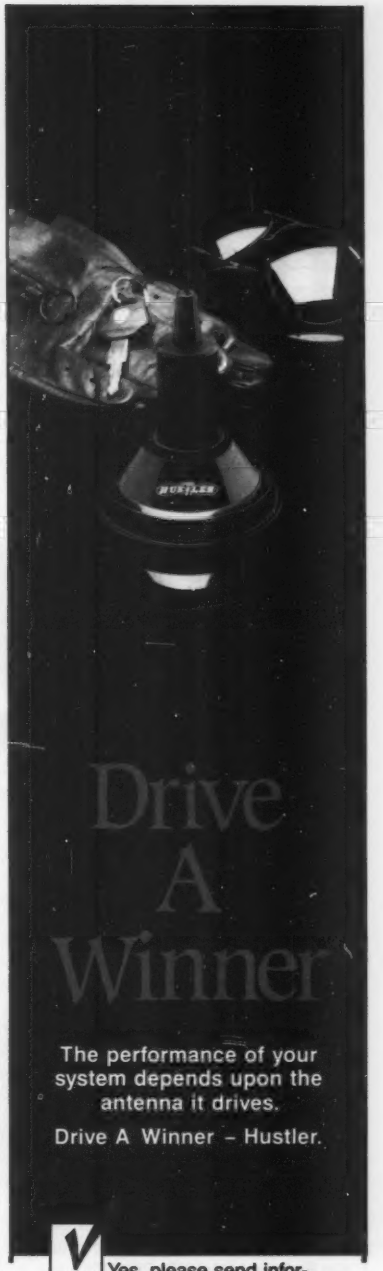
Operating Tips

In keeping with the unit's small size, there is no sidetone built in. Nearly all HF rigs provide one anyway. With the keyer in your palm, the paddles should rest between your thumb and index finger. Lefties can build the whole thing in mirror image.

The first time I tried it, RF from the mobile whip locked up the rig, and I got a nasty RF burn from the keyer's output jack. Switching to a shielded connection cable and wrapping it through toroids, one on each end, solved the problem. I've since made numerous contacts, and the little unit has performed like a champ.

This handy little keyer is good for Field Day, QRP, contests, and VHF CW, as well as HF mobile. Anywhere you need it, the Kaboom Micro Keyer will give you a handful of pure iambic power. And jaws will drop at the local radio club when you pass it around! 73

Michael Geier KB1UM is 73's trouble-shooting "Ask Kaboom" columnist. You can reach him at 7 Simpson Court, S. Burlington VT 05403.



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CIRCLE 269 ON READER SERVICE CARD

73 Review

by Marc Stern N1BLH

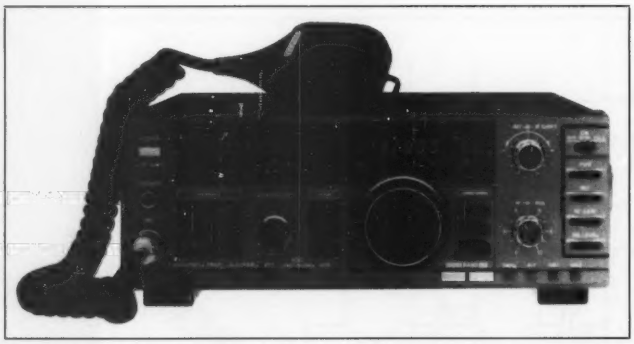
Kenwood TS-680S HF Transceiver

Improvements on the trusty TS-140S.

Kenwood USA Corporation
2201 E. Dominguez St.
Long Beach CA 90801-5745
Tel: (213) 639–4200.
Price Class: $1150

What Is the 680S?

In brief, Kenwood took the TS-140S, a high performance uncomplicated HF mobile rig, and added to it 6 meters and a receive preamp that is active beginning at 21 MHz. (See review of the 140S in the April '88 issue of *73*.) Like the 140S, the 680S has a general coverage receiver, but even the receiver has an added feature—45 to 55 MHz, low VHF coverage.



The Kenwood TS-680S. It is a twin to the 140S, with 6 meters and preamp added.

Close Brothers

Since the 140S and 680S are so similar, I don't elaborate on the features here. I list them, though, for those not familiar with the 140S.

The front panel of the TS-680S contains 34 controls, which are clearly labeled, and ergonometrically well-laid out. Those with thick, blunt fingers, though, should check the rig out before buying, since some of the buttons are small.

Like all modern HF rigs, the 680S is microprocessor-controlled. It has a multi-function display that gives not only mode, but also frequency, memory channel, mode, RIT, VFO (there are two), and frequency to 10 Hz. There are also on-air indicators, as well as a series of LEDs that light up when you activate the memory scroll and allow you to see the contents of the 31 memories, or frequency lock.

Other notable features include memory, VFO, and programmed scanning; a multifunction S-meter; LSB, USB, CW (QSK), AM, and FM modes; split operation; 8.8 kHz range RIT; IF shift to tune out QRM; 20 dB of front-end attenuation to protect your rig from local high-power stations; and speech processing.

The rear panel contains connectors for the antenna and DC power. Two accessory jacks allow computer control and operation, as well as remote control.

The rig is also fairly compact because it has a built-in cooling fan (like the ICOM IC-735) that eliminates the need for a heatsink.

Something Gained, Something Lost

The only 140S standard feature that's nonstandard on the TS-680 is VOX operation. Since the chassis of the 680 and its predecessor are essentially the same, something had to make way for the pre-amp.

For many hams, it's a more than acceptable trade-off. There are some operators who prefer VOX—and it's an accessory option offered for the 680. Many, though, are happier with PTT operation. Finding the proper VOX level in many rigs can be very tricky business, especially if the rig isn't thoroughly grounded. Without thorough RF grounding, ambient RF tends to creep up, and into, the microphone, and key up the rig unless you have the VOX set at such a high threshold that a thundering herd of elephants couldn't activate it! So I, like many others, prefer the lack of complication PTT operation offers.

A few years ago, VOX was far more important because it allowed me semi-break-in CW keying. However, the TS-680S features built-in QSK or semi-QSK, obviating that need.

Why the Pre-Amp?

As you move up toward VHF, such rigs tend to generate their own system noise, which is superimposed on any atmospheric noise your rig picks up. This combo can often drown out weak signal stations. A super front end helps, and a pre-amp—a device that amplifies incoming signals just as they arrive to the rig—can make all the difference in the world.

Testing the Specs

Kenwood rates the 680S at 110 watts out, and my testing confirms this. The 680 consistently pumped 80 to 110 watts into a 50Ω resistive load and kept this up for a long time on the HF bands. From 50 to 54 MHz, it puts out only 10 watts, so you may want to think about getting an amp. VSWR protection came on over 1.5:1, which is something that has been common in other Kenwood gear I have tried.

I found that the pre-amp adds about 1.5 S-units to the receive capability of the rig (roughly 10 dB or so).

Suggested Improvements

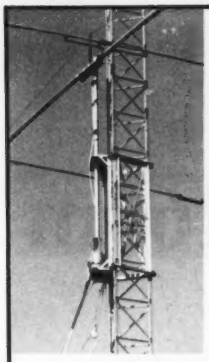
Overall, I have surprisingly few nits to pick at in the TS-680S, and those that I do have are easy to live with. For starters, I found that the power slide switch is anything but linear. A small movement produced a radically large increase in output power. Kenwood would be well-advised to swap the power output function with one of the knobs, or combine it with a concentric control knob surrounding one of the other control knobs.

I also found the display a little dim in bright daylight when I used the 680 mobile. Next, at 10 inches by 11 inches by 4 inches, and weighing 13 pounds, it may be a little bulky for smaller cars such as sub-compacts.

Finally, the (two) slide control noise blankers are effective against ignition noise and pulse-type "woodpecker" noise, but after a point they also affect the quality of the signal, causing it to pump and become distorted. All you have to do is remember to keep the adjustment below halfway and you'll be okay.

Conclusion

To sum everything up, I found the TS-680S multibander quite a good radio. It measured up to, or exceeds, its specs and is a pleasure to operate. The addition of the six meter module and pre-amp makes it a good value for the few extra hundred dollars the 680S lists for over the 140S. 73



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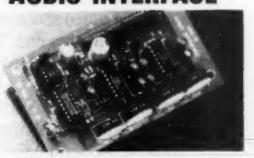

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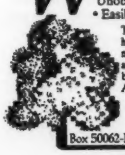

There's a 20 meter antenna with real DX Punch hidden in this picture. You can't see it, and your neighbors can't either. But it works DX barefoot anyway. How about a low profile 80/40/30 tribander? Or a 2 element monobander for the attic? All easily fit the pocketbook--Priced $29 to $99.

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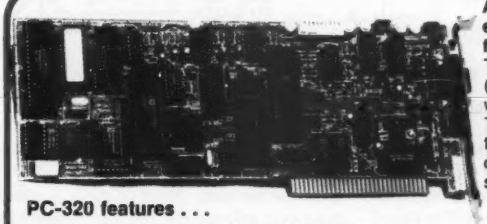

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CIRCLE 152 ON READER SERVICE CARD

3/4 Inverted "U" for 160m

Be heard on the Gentlemen's Band.

by Alan Hoffmaster WA3EKL

Twelve years ago, when I decided to start some serious contesting, I immediately realized that I needed a good 160 meter antenna. That presented a problem, since my backyard was 63 feet wide and 140 feet deep.

About 60 feet from the house, my one lonely 65-foot guyed tower stood. Hanging from one end was a 20-foot pressure treated 2 x 4 with a 75 meter inverted vee; hanging off the other end was a 40 meter inverted vee. A 3-element, 75 meter sloper array hung from the top. A tribander and monoband antennas were living at the top, as well as down the sides, of my tower.

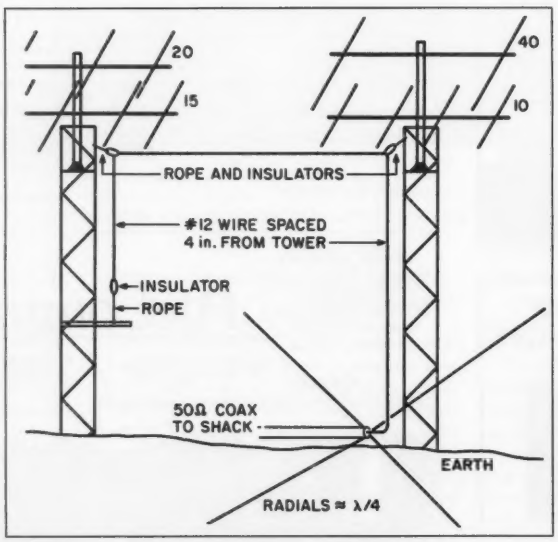

Diagram of WA3EKL's 160m inverted "U" antenna.

Experimenting with Shunt Feed

After reading a considerable amount on 160 meter antennas, I first decided to shunt-feed the tower. The shunt consisted of a #10 copper wire that ran parallel to the tower and stood off from it by four feet. The top of the wire attached to an aluminum pipe, grounded to the tower at fifty feet up. I fed the bottom end of the wire with 50Ω coax through a 250 pF capacitor. I attached the shield of the coax to six radials strung out in the yard. With this system, I could cover about 50 kHz without going over 2:1 SWR. The antenna got out, but that's all I can give it.

According to the material I read, mounting a tribander or monobander at the top of the tower would make the tower "look" longer, and make it easier to load on 160 meters. My experience, however, didn't bear this out at all. In the course of some years, I had seven different configurations at the top of my tower, ranging from two stacked beams, to nothing but the mast pole jutting up seven feet from the top plate. None of these combinations ever affected the 160 meter shunt feed system!

Simpler Way to 160

About five years ago, I installed another tower 55 feet away from my original tower.

"I can tune from 1.8 MHz to 1.9 MHz without going over 1.8:1 SWR."

See the figure. I cut a ¼-wavelength of #12 copper wire for 160 meters and connected one end directly to the center conductor of a piece of coax that went to the transmitter. The coax shield attached to the same ground radial system I used for the shunt system.

I strung the wire 65 feet up the side of the original tower to the top, four inches from the tower, then across the sky, parallel with the ground, to the other tower and down the side of this tower, also standing it off by four inches. I insulated the wire from both towers using rope and pieces of wood.

The first SWR check indicated resonance out of the top of the band, so I added about twenty feet of wire to the free end. The SWR was now 1:1 at 1.850 MHz. I can tune from 1.8 MHz to 1.9 MHz without going over 1.8:1 SWR.

I had found a solution: the inverted U, a modification of the old inverted L.

Good DXing

The antenna works extremely well. During DX contests I can work anything I can hear. In fact, it is a bit of an alligator. The DXers hear me better than I hear them.

If you are going to try this antenna, I would suggest that you raise the first vertical section of wire to the highest support you can find. Then stretch the rest of the wire to the next highest support you can find. If you have any wire left over, let it hang down on a weight, or tie it off with a rope. To tune the antenna, add or subtract wire to this end. Good luck, and I hope I hear you on the top band! 73

Alan Hoffmaster WA3EKL has been a ham for 25 years, and he enjoys creating and testing antenna systems. His address is 929 Andrews Road, Glen Burnie, MD 21061.

HAM PROFILES

There are no "average" hams!

Ham in the Limelight

Eighteen-year-old Kelly Howard N6PNY discovered amateur radio—from her parents—at age thirteen. After studying with the Convair ARC, Kelly became KB6DOS, and upgraded to General two years later. A chance meeting with Fried Heyn WA6WZO in a San Diego amateur radio supply store led to her appearing in the *New World of Amateur Radio* videotape.

In February, Kelly was back in front of the camera interviewing retired US Senator Barry M. Goldwater K7UGA for the pilot of an in-school children's TV program, *Today's People*. Two months later, she and her co-star from the *New World of Amateur Radio*, Nathan Pyle KB6PLH, attended the Dayton Hamvention with expenses paid by the Convair ARC and several other clubs. Kelly was invited to sit at the dais with banquet speaker Dave Bell W6AQ and Ham of the Year Bill Pasternak WA6ITF.

Kelly graduated from high school this year and will study broadcast journalism in college this fall. She has been promised an internship at a Los Angeles television station. While Kelly continues working with *Today's People*, she is also one of the regular anchors of the Westlink Amateur Radio Newsline reports. Thanks to ham radio, life is never dull for Kelly Howard N6PNY.

Kelly Howard N6PNY—high profile ham.

Multi-Talented Ham

Hugh Morris Archer W8JA, born on June 22, 1916 and now living in Dearborn, Michigan, became interested in radio when he was twelve. He started off his long career in hamming when his science teacher gave him a diagram and parts to a one-tube radio. He put it together and they spent many happy hours together.

Hugh, known to fellow hams as W8JA, belongs to ROAR, the Rotarians of Amateur Radio. His favorite way to spend a Sunday morning is to get on the air at 7 AM. As the sun moves west, so do his conversations: from Greece to Finland, Sweden, Norway, Germany, France, England, Italy, then Canada, the East Coast, and South America.

On July 1, 1989, he took office as President of Rotary International. For a year, he will head an organization of more than one million business and professional members in 165 countries. He finds amateur radio great for helping with serious Rotary business, such as disaster relief. "Amateurs have made many contributions to the science of communication," he says, and good communication is one reason the Rotary is a successful service organization.

Hugh M. Archer W8JA—inventor, business executive, scientist, engineer, sportsman, attorney, researcher, community leader.

Among his many achievements are six inventions registered with the US Patent Office, two of which built his plastics extrusion industry, the Spiratex Company in Romulus, Michigan. One is for a spiral winding process and apparatus, another for a method of forming plastic rods and profiles. He has also invented medical equipment and several types of light meters.

To obtain guidelines to submit items to Ham Profiles, call Joyce at 603-525-4201 Ex. 551, or download them from the 73 BBS (PH: 603-525-4438, 8 data bits, no parity, one stop bit). ■

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Feedback#	Title
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2	Never Say Die
3	QRX
4	Home-Brew: 30 Meter Trap for AV-4
5	Review: AEA AT-300
6	Home-Brew: 12 and 17 Meter Dual-Band Beam
7	Home-Brew: Kaboom Micro Keyer
8	Review: Kenwood TS-680S HF
9	Home-Brew: 3/4 Inverted "U" for 160m
10	Ham Profiles
11	Home-Brew: The Hamfester
12	Vertical Antennas at HF
13	Home-Brew: Safari Special
14	Home-Brew: Beefing Up the Uniden
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The Hamfester

This unit gives you easier and longer range HT communications in crowds.

by Rev. Kenneth D. Wells NM9P

Hamfest season was approaching quickly and I needed a way to keep in touch with my buddies (and the XYL) while browsing through the flea market. I hated the stabbing pains I got when my rubber duck antenna jabbed me in the side. Besides, range was not very good with the antenna tucked neatly under my armpit. There had to be a better way. Here is how my solution evolved.

At the Dayton Hamfest I found a booth selling the Duckie Clip™, a three-foot coax extension with a spring clip, for about ten dollars. You could make it for less than ten dollars, but buying this model saves lots of time, and the construction quality is excellent. With this neat little item, I could clip my rubber duckie to my hat, and leave the HT on my belt. The effective communications range increased greatly: Now my buddies and I could find each other for lunch!

I clipped my speaker mike to my collar where I could hear everything on the frequency. This worked, but there were several problems. In a noisy location, I couldn't hear the tiny speaker. In a quiet location, everyone else could hear it and gave me dirty looks. Whenever someone called, I always seemed to have something in my hand that kept me from grabbing the mike and answering back. There had to be a better way.

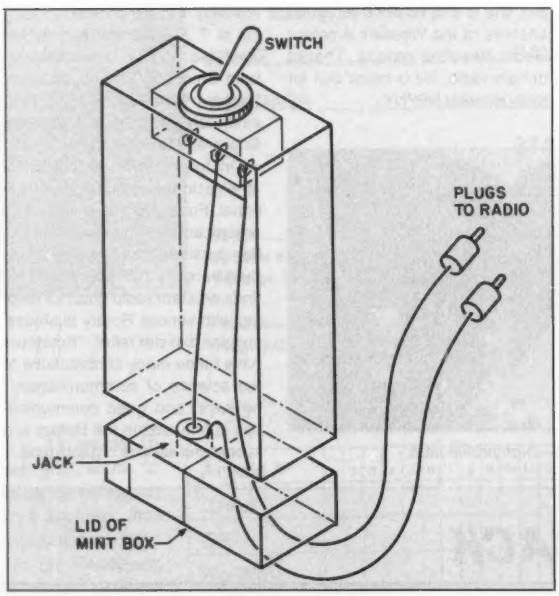

Figure 1. Physical layout of hamfester.

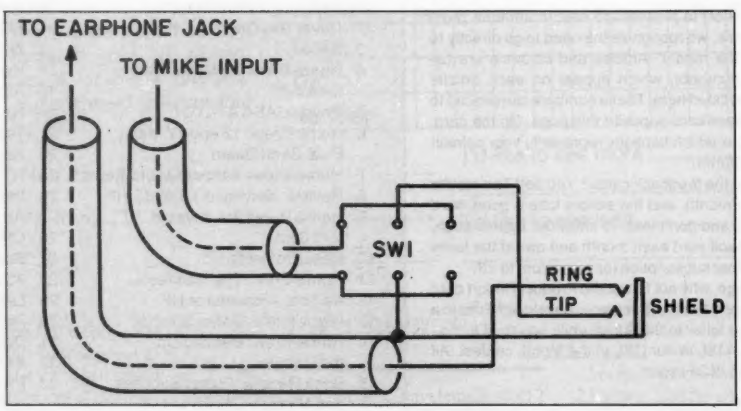

Figure 2. Hamfester wiring diagram

The Better Way

Some of my buddies bought boom mike headsets. They looked like just the solution, so I priced one on my next trip to the ham equipment dealer. Wow! $55! I'm basically cheap, so nix the headset.

Soon, however, I noticed that K-Mart was selling a boom headset telephone for $20, which soon dropped to less than $14! The phone consists of a boom mike with a single earpiece. It connects to an interface box by means of a miniature stereo plug. BINGO! All I needed was another interface box and I could use the headset for both telephone and ham radio. (By the way, it works nicely as a telephone, but you need another phone to do the dialing.)

I built the interface box into the plastic case from a pack of breath mints (about 50 cents in any grocery store). All I needed was a mini-stereo jack, a center off spring return DPDT switch, two short lengths of RG-174 or other shielded wire, a miniature stereo plug, and a subminiature phone plug. I bought these at Radio Shack.

Drill carefully into the bottom of the plastic case—the plastic splits easily. The switch fits perfectly into the case (Figure 1). To install the jack, drill or ream a hole slightly smaller than the jack diameter into the soft plastic lid, and press in the jack. There is no room for a

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IC-781 Xcvr/Rcvr/ps/tuner/scope	6149.00	**5295**
IC-761 Xcvr/Rcvr/ps/tuner ***(Closeout)***	2699.00	**2295**
HM-36 Scanning hand microphone	47.00	
SP-20 Ext. speaker w/audio filter	149.00	**139.95**
FL-101 250 Hz 1st IF CW filter	73.50	
FL-53A 250 Hz 2nd IF CW filter	115.00	**109.95**
FL-102 6 kHz AM filter	59.00	
EX-310 Voice synthesizer	59.00	
IC-751A 9-band xcvr/.1-30 MHz rcvr	1699.00	**1469**
PS-35 Internal power supply	219.00	**199.95**
FL-63A 250 Hz CW filter (1st IF)	59.00	
FL-52A 500 Hz CW filter (2nd IF)	115.00	**109.95**
FL-53A 250 Hz CW filter (2nd IF)	115.00	**109.95**
FL-33 AM filter	49.00	
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IC-735 HF transceiver/SW rcvr/mic	1149.00	**999.95**
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BC-35 Drop in desk charger for all batteries	79.00
BC-16U Wall charger for BP7/BP8	21.25
LC-11 Vinyl case for DIx using BP-3	20.50
LC-14 Vinyl case for DIx using BP-7/8	20.50
LC-02AT Leather case for DIx models w/BP-7/8	54.50

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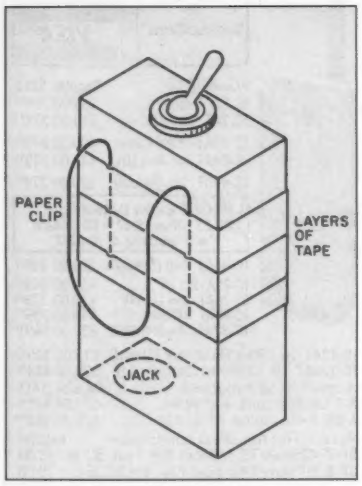

Figure 3. Hamfester pocket clip, made from a jumbo paper clip.

Parts List

(Numbers with "RS" are from Radio Shack)

Part	Source	Cost	
HS1 Headset Telephone	K-Mart	$13.88	
J1 Miniature Stereo Jack	RS 274-249	$ 0.80	(2 for $1.59)
J2 Miniature Stereo Plug	RS 274-284	$ 1.10	(2 for $2.19)
J3 Subminiature Phone Plug	RS 274-290	$ 0.75	(2 for $1.49)
S1 DPDT C.O. Spring Return	RS 275-637	$ 3.69	
Shielded Mike Cable	RS 278-752	$ 3.29	for 30 feet
"Duckie Clip"	Hamfest vendor	$ 9.95	
Case (Tic-Tac Mints)	Grocery store	$ 0.45	(including mints)
Total Cost:		$33.91	
Stereo Headphone	Discount Store	$ 4.95	(plus or minus)
M1 PC-Mount Electret Mike	RS 270-090	$ 1.39	(sale price $0.99)
Heat Shrink Tubings	RS 278-1627	$ 0.26	(7 for $1.79)
Total Cost (without Phone):		$26.63	

I got most of these parts during sales at Radio Shack, so they were much cheaper.

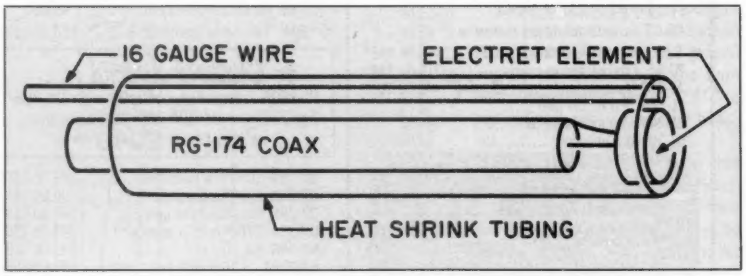

Figure 4. If you can't find the boom mike at K-Mart. . . home-brew it!

nut, but the soft plastic grips the jack tightly enough.

Following the wiring diagram in Figure 2, connect all wires before the final installation of the switch and jack. Cut a notch into the lid just large enough for the cables to fit through. Hold the lid closed with a layer of electrical tape. Bend a jumbo paper clip into a folded "U" and fasten it to the interface box with another layer of electrical tape (Figure 3). Now the box will hang nicely on a shirt pocket or belt.

My HT, a Kenwood TR-2600, switches differently than other HTs. The earphone connects to a subminiature plug. I wired this straight through. The mike is wired to the center connection of the miniature stereo plug. T-R switching occurs when the ground of the mike jack is connected to the ground connection of the earphone jack. The DPDT switch ensures that both the center conductor and the ground of the mike are completely disconnected from the circuit when in standby. Otherwise, leakage through the electret mike causes the transmitter to key up.

Adaptations

You can use this mike and interface box with other hand-held radios. Just change the plugs to match your rig. The ICOM IC-2AT uses the subminiature plug for mike input and miniature plug for the earphone. You may need to solder a 33k resistor across the cable at the switch to maintain a good key-up of the transmitter. Some radios need it, others don't. If yours works fine without it, leave it out. Be sure that the resistor is soldered on the mike side of the switch and not the radio side, or the rig will be constantly keyed up. This will get you a dead battery and lots of enemies.

Communication is now just a flip of a switch away. I can hear the gang calling, even in a noisy room, and I don't disturb other people in a quiet room. I even sat through the Packet Radio forum at Dayton and listened to my buddies make the lunch date, without missing a byte!

Home-brew a Headset

If you can't find this headset telephone, or one like it, you can build your own using a cheap set of stereo headphones. First, build a boom mike using a 99-cent electret element from Radio Shack. Use RG-174 or other small shielded wire for the feedline, and place a length of 16 gauge wire alongside it for stiffness (Figure 4).

Encase the works in heat shrink tubing. Use two or three concentric short lengths of heat shrink right next to the mike element. This gives a neat tapered look and adds to the strength of the assembly. Leave a few inches of the 16-gauge wire extending from the shrink tubing and twist it to the headset band. Then, just cut off one of the earphones and use the remaining cable to connect to the boom mike. Voila! A headset and boom mike. You can use either side for the headphone, just remember to wire the jack on the interface box accordingly.

I have constructed several of these headsets and used them in different configurations on my ICOM IC-745 on the low bands. They are a joy during contests, but describing that needs another article!

Convenience

This headset is also very handy for public service communication at parades, walk-a-thons, etc. The headphone keeps conversations private and does not disturb others. Hands are now free to write, browse, eat, or bandage knees. The extra three feet of height and clear shot for the antenna really increases communication range. As an added plus, NO9N in Vincennes discovered that when wearing the typical "baseball cap" (with call sign and club emblem, of course) the mike may be pivoted up under the bill and it still works like a champ. Evidently the bill reflects the sound back into the mike much like in a PZM microphone. Many people may be unaware that you have a mike at all, and wonder why you keep talking to yourself!

I have had a lot of fun with this headset combo. The best fun was showing it off at the local ham club meeting and hearing all the oohs and aahs from fellow club members! After all, "I built it myself!" 73

Rev. Kenneth Wells NM9P is President of the Old Post Amateur Radio Society and Pastor of the Wabash United Methodist Church in Vincennes, Indiana. Contact him at 212 West Central, Greensburg IN 47240.

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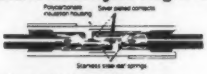

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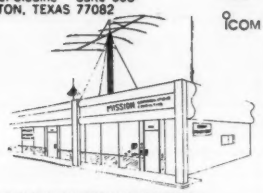

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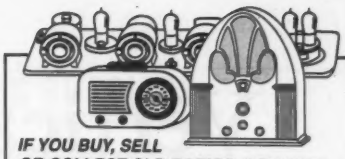

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CIRCLE 1 ON READER SERVICE CARD

Vertical Antennas at HF —Part I—

This tutorial uncovers surprising facts about vertical HF antennas.

by Stan Gibilisco W1GV

The Misunderstood Vertical

Hams often disparage HF verticals. They criticize them as antennas that "radiate equally poorly in all directions," that require an extensive ground-radial system to get out at all, and that are too noisy for reception.

Well, there's more to the story than the blanket statements above suggest. When properly set up, verticals—even those without radials—are fine performers on both transmit and receive. This two-part tutorial will serve to separate fact from fiction. But first, a little background.

Polarization

An electromagnetic wave, as the name suggests, has two components—an electric (E) wave and a magnetic (H) wave. These components propagate in planes 90 degrees to each other. When we talk about the polarization of a wave, we typically mean the E-wave orientation. A vertical antenna radiates E-M waves whose E-fields are mostly vertically polarized. It also receives most effectively when the incoming signal is vertically polarized.

In free space, the attenuation presented by a vertical antenna when the incoming signal is horizontally polarized is 30 dB. In practice, however, many factors serve to alter signal polarization. When the wave is a ground wave, then hills, telephone and electric wires, steel-frame buildings, and even trees refract E-M waves and rotate their polarization. (Note, though, that they do not significantly absorb wave energy at HF—regardless of the polarization.) The ionosphere also rotates the HF wave around its propagation axis, altering its polarization and so causing the sky wave to arrive back to Earth with varying polarization. This is why a horizontal antenna works for reception of sky-wave signals that have been transmitted originally by a vertical antenna, and vice versa.

Low Band HF Ground Wave

So, you can see that sky-wave propagation for vertically and horizontally polarized signals at HF differs little. However, the surface wave—a signal that travels using the ground as a conducting circuit—is limited to line-of-sight for horizontally polarized HF signals. This is because their E-M fields are short-circuited by the ground. With vertical polarization, however, the ground doesn't short circuit, but actually assists E-M field propagation over its surface (see Figure 1).

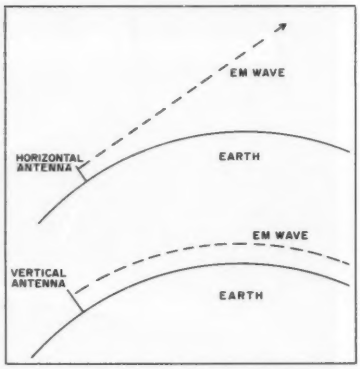

Figure 1. Electromagnetic waves from (a) a horizontal antenna and, (b) a vertical antenna. This pattern h[illegible]s true for wave energy up to 10 MHz.

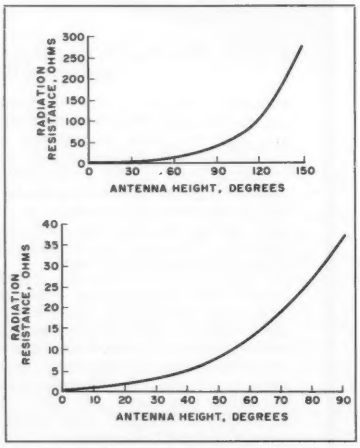

Figure 2. Radiation resistance as a function of height for a vertical radiator over perfectly conducting ground. The feedpoint is assumed to be at the base of the antenna. (a) shows heights from 0–150 electrical degrees. (b) shows them only from 0–90 electrical degrees.

This effect is very slight at frequencies above about 10 MHz because of ground loss, but, as the frequency is lowered, the surface wave reaches further and further from the transmitting antenna. While surface-wave propagation is limited to the radio (line-of-sight) horizon above 10 MHz, a high-powered (1.5 kW output) station may be heard at distances of about 50 miles at 7 MHz, 100 miles at 3.5 MHz, 150 miles at 1.8 MHz, and 200 miles in the standard AM broadcast band in the daytime, all when there is little or no sky-wave propagation.

This is why antennas for standard AM broadcast are almost always vertical! They radiate vertically, so that surface-wave propagation is optimized for maximum coverage during daylight hours.

At frequencies above 10 MHz, there is little difference in coverage between vertically and horizontally polarized wave energy, all other factors being equal.

Longer Skip Length

Vertical antennas (at frequencies below about 10 MHz) often provide good radiation at small angles relative to the horizon, which often enhances DX. A vertical antenna ¼ wavelength high, fed against perfectly conducting ground, will usually radiate most of its energy at an angle of less than 45 degrees with respect to the horizon.

DXers like this because, the lower the angle of radiation from an antenna, the greater the single-hop sky-wave propagation distance will be, requiring fewer hops to reach a given distant point. The upshot is that a signal travels a greater terrestrial distance with less attenuation.

Horizontal antennas must be at least ½ wavelength off the ground to obtain the same low-angle characteristics as a well-designed and installed quarter-wavelength vertical antenna.

Table 1 shows approximate heights of a ¼ wavelength vertical antenna, based on frequency (MHz). Heights are shown for the amateur bands at 160, 80/75, 40, 30, 20, 15, and 10 meters. Lengths are shown for bottom and top band frequencies, except in 30, 20 and 15 meters. The general formula is:

$$L = 230/f$$

where L is length in feet and f is frequency in MHz.

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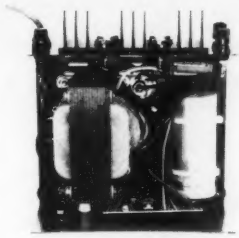

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RM-12M	9	12	5¼ × 19 × 8¼	16
RM-35M	25	35	5¼ × 19 × 12½	38
RM-50M	37	50	5¼ × 19 × 12½	50

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MODEL RS-7A

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RS-4A	3	4	3¾ × 6½ × 9	5
RS-5A	4	5	3½ × 6⅛ × 7⅛	7
RS-7A	5	7	3¾ × 6½ × 9	9
RS-7B	5	7	4 × 7½ × 10¾	10
RS-10A	7.5	10	4 × 7½ × 10¾	11
RS-12A	9	12	4½ × 8 × 9	13
RS-12B	9	12	4 × 7½ × 10¾	13
RS-20A	16	20	5 × 9 × 10½	18
RS-35A	25	35	5 × 11 × 11	27
RS-50A	37	50	6 × 13¾ × 11	46

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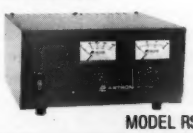

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RS-35M	25	35	5 × 11 × 11	27
RS-50M	37	50	6 × 13¾ × 11	46

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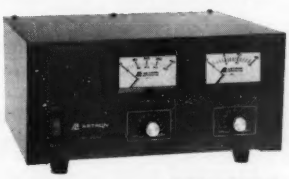

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VS-20M	16	9	4	20	5 × 9 × 10½	20
VS-35M	25	15	7	35	5 × 11 × 11	29
VS-50M	37	22	10	50	6 × 13¾ × 11	46
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VRM-50M	37	22	10	50	5¼ × 19 × 12½	50

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• Built in speaker

MODEL	Continuous Duty (Amps)	ICS* Amps	Size (IN) H × W × D	Shipping Wt. (lbs.)
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RS-10S	7.5	10	4 × 7½ × 10¾	12
RS-12S	9	12	4½ × 8 × 9	13
RS-20S	16	20	5 × 9 × 10½	18

*ICS—Intermittent Communication Service (50% Duty Cycle 5min. on 5 min. off)

CIRCLE 16 ON READER SERVICE CARD

When Ground is Important

A good, highly conductive ground system is essential if a quarter-wave resonant vertical antenna is to perform well. This doesn't always hold true, however, for a half-wave vertical antenna, the other common type of vertical antenna.

The ground reflects electromagnetic energy. Ideally the ground would act like a copper plate—that is, as a perfect conductor and reflector—but this is not true of real earth. Salt water comes closest to the ideal; and black earth and fresh water are also fairly good. The conductivity of sandy and rocky, dry soil is the poorest, scarcely better than no ground at all. You can improve ground conductivity by burying radial wires a few inches below, or stringing them along, the Earth's surface.

Your antenna should have as high a radiation resistance as possible compared to the ground resistance, since the higher that ratio, the greater the proportion of the wave energy entering the antenna/ground system that radiates into the atmosphere. You can achieve this favorable ratio by 1) designing your antenna system to have a greater radiation resistance, 2) by reducing your ground resistance or 3) both. Clearly, a good, low-resistance ground becomes more important as the radiation resistance of an antenna decreases.

It is a fascinating concept, but we will go into only enough detail to graph the radiation resistance as a function of antenna height in electrical degrees (Figure 2a,b).

For a base-fed vertical, the radiation resistance increases with the height of the antenna element. Note that for a vertical 90 degrees (¼ wavelength) high, the radiation resistance is about 37Ω. For an antenna 180 degrees (½ wavelength) high, the radiation resistance is very high, on the order of hundreds or even thousands of ohms, depending on the ratio of conductor diameter to conductor length.

As alluded to above, the efficiency—the amount of wave energy radiated into the atmosphere—of a vertical, base-fed antenna depends on the ratio of the radiation resistance to the total resistance in the antenna system. The total resistance, R_T equals the sum of the radiation resistance R_R and the loss resistance R_L. The value of R_L is determined by the conductivity of the ground in the vicinity of the antenna, and by loss in the antenna conductor and the feedline. In most antenna systems the conductor and feedline loss is less than 1Ω, but the ground loss may be much greater. It is not at all unusual for the ground resistance to exceed the value of 37Ω. This means that it is quite possible for a quarter-wave vertical antenna to have an efficiency of less than 50 percent.

The formula for antenna efficiency, *Eff*, is:

$$\text{Eff}(\%) = 100R_R/(R_R+R_L)$$

For example, suppose we have a quarter-wave vertical antenna with a loss resistance of 15Ω. Then $R_L = 15$ and $R_R = 37$, according to Figure 4. We calculate:

$$\text{Eff}(\%) = 100(37/(37+15)) = 100(37/52) = 71 \text{ percent}$$

Interestingly, this total resistance $R_T = 52\Omega$ means that the antenna, at resonance, will show a perfect 1:1 SWR with 52Ω coaxial feed. We might add a system of 100 radials, each ½ wavelength long, to this antenna and reduce R_L virtually to zero; then $R_T = 37\Omega$ and the efficiency would be 100 percent, but the SWR would rise to 52/37 or 1.4:1. The extra loss caused by the imperfect match on the feedline would be less than the minimum loss detectable, even if the listener were expecting it. But the loss caused by an efficiency of 71 percent as compared with 100 percent would be 1.5 dB, a quite noticeable amount.

Suppose now we put a half-wavelength radiator in place of the quarter-wavelength, and install a matching transformer for the feedline. The radiation resistance of this radiator will be very high, probably at least 600Ω and most likely even more than that. If the loss resistance is still 15Ω and we assume $R_R = 600$, then:

$$\text{Eff}(\%) = 100(600/600+15)) = 100(600/615) = 96 \text{ percent}$$

By installing the radials, we gain only 0.2 dB or so—not perceptible even if the listener were expecting it.

The above shows that a good ground isn't critical for half-wave radiators, but is very desirable for quarter-waves, for improving antenna radiation efficiency.

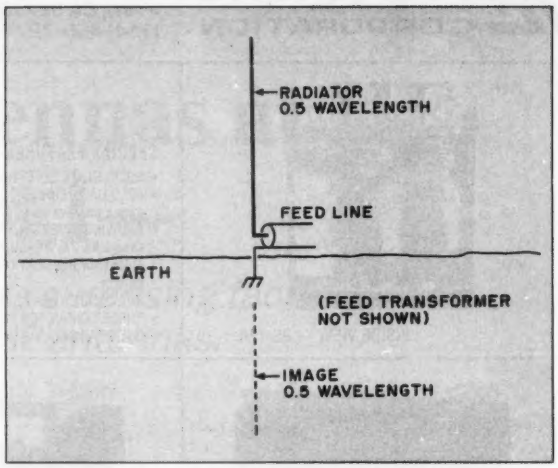

Figure 3. A half-wave vertical antenna without radials, assuming fair-to-good earth conductivity. You need to install radials on this system if the ground conducts poorly.

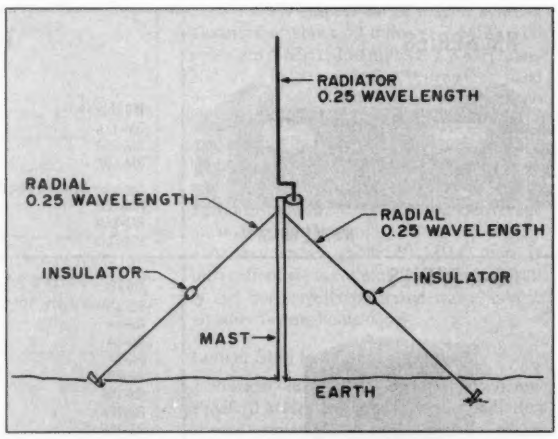

Figure 4. Ground-plane antenna in which the radials do double duty as guy wires. There should be at least three of them.

Ground Planes

A good ground plane is desirable for any vertical radiator because of the reflected image it provides. This "image antenna" produces low-angle omnidirectional gain, especially for a half-wave antenna. In this case the "image antenna" and the actual antenna act like a 2-element collinear array, producing 3 dB power gain over a half-wave radiator working against poorly conducting ground (Figure 3).

The term "effective ground" refers to the physical location of the radio-frequency ground plane. With perfectly conducting ground this would of course be the surface of the Earth in the vicinity of the antenna. If a vertical antenna has an extensive system of radials, then the effective ground is the surface (a plane or cone, usually) described by the web of radials.

For a ground-mounted antenna fed at the base or anywhere else along its height, consider the surface of the Earth as the effective ground location, disregarding minor irregularities, even though the conductivity of the ground may be poor. The primary difference between poorly conducting ground and a surface with near-perfect conductivity is in the loss resistance and in the ability (or lack of ability) of the ground to provide a mirror image of the antenna for gain purposes.

A radial system for efficiency is necessary in the case of a quarter-wave antenna, and for omnidirectional gain in the case of a half-wave antenna. Installing ground radials is *mandatory* for ¼-wave efficiency if the soil

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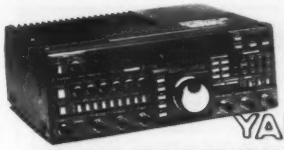

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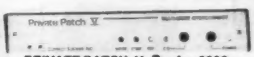

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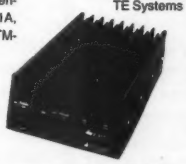

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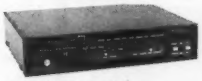

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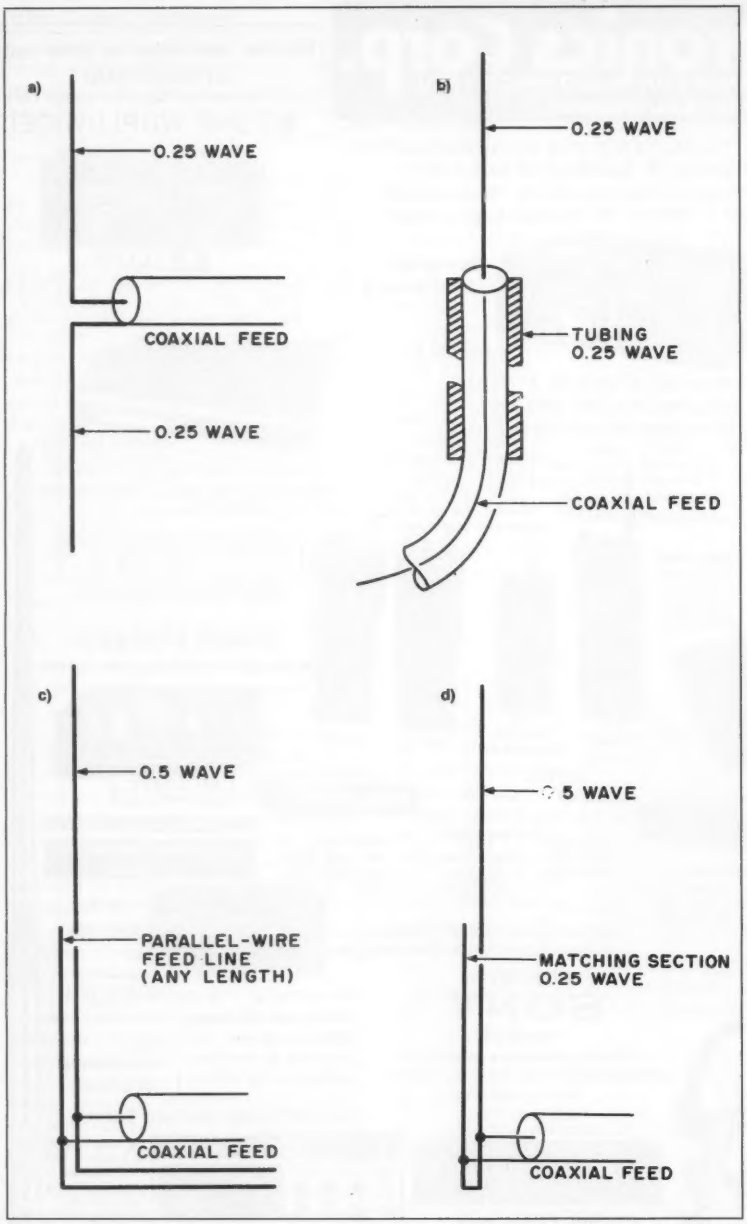

Figure 5. Four radial-less vertical antenna systems: (a) a center-fed vertical dipole; (b) the feedline runs up through the center of the lower tube section of the vertical dipole; (c) a vertical Zepp, the half-wave fed with open-wire line; (d) a variation of the Zepp, commonly known as the J-pole.

poorly conducts. They are still more critical for inductively loaded (short) verticals.

Radial Systems

How many radials does a ground-mounted antenna require? This depends on the type of soil and the available space for installing the radials. Broadcast stations on the standard AM band use upwards of 100 radials, all ½ wavelength. As a rule, at least four ¼-wavelength radials are standard for a quarter-wave ground-mounted vertical antenna, and at least four ½ electrical wavelength for a half-wave vertical antenna. Get them at least as close to that as possible. To a point, you can make up for radial shortness by adding more of them.

It doesn't matter from an electrical standpoint if the radials are buried or laid on the surface or even strung a few feet above the surface. Nor does it matter if the wires are insulated or bare.

Sometimes radial systems are designed for multiband quarter-wave vertical antennas, in which two or more radials are installed for each band. With a ground-mounted antenna this is a misconception—the more the merrier, and make them all at least ¼ wavelength and preferably ½ wavelength for the lowest frequency used.

The Above Ground-Plane Antenna

A vertical antenna does not have to be mounted at ground level. In fact, there are advantages to mounting a ¼-wave vertical well above the surface. If such an antenna is at least ¼ electrical wavelength above the ground, just two or three radials allow good radiation efficiency. Guy wires may double as radials in this installation (see Figure 4).

Cut the radials at ¼ wavelength at the operating band. For multiband antennas, as above, install at least two radials for each band, and space them apart (ideally) equally around a circle. The best slant angle for these radials is 45 degrees, as this gives a feedpoint impedance of nearly 52Ω, providing a good match to most common coaxial cable.

For ground-plane antennas installed less than ¼ wavelength above the ground at the lowest frequency used, add four radials for those bands at which the height of the feedpoint is less than ¼ wavelength, eight at ⅛ wavelength, and so on. In other words, add "n" radials for the band that is less than "1/n" wavelength above the ground. This will give near 100 percent efficiency for a quarter-wave vertical antenna at all operating frequencies.

If a half-wave vertical antenna is placed above the surface, the radials should be resonant at ½ wavelength. The height above ground is not too important, but try to make it at least ¼ wavelength. Use at least two radials for this arrangement.

Vertical Antennas Without Radials

For an end-fed, quarter-wave conductor to work well in most situations, you need radials. Some configurations, however, don't require them. Figure 5 gives four such examples.

At (a), a half-wave dipole is simply turned on its end. The feedline, either balanced or unbalanced, comes away at a right angle to the antenna—that is, horizontally—for a distance of ¼ wavelength or more. If you use open-wire, low-loss line, you may operate this antenna on all bands that are integral multiples of the frequency at which the antenna is ½ wavelength, and obtain resonance. With a wide-range tuner, this antenna loads on all frequencies down to that at which the whole antenna is ¼ wavelength.

At (b), a half-wave antenna is fed by running coaxial cable up inside the lower ¼-wave section. The outer conductor of the feed cable connects to the lower "sleeve" and the inner conductor connects to the top section. This is essentially a ground-plane antenna with the radials folded down into a vertical cylinder that completely surrounds the feed cable. It presents a feedpoint impedance of about 70Ω at the frequency where the whole radiator is ½ wavelength.

Continued on page 46

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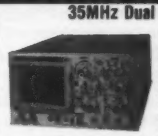

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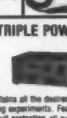

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CIRCLE 356 ON READER SERVICE CARD

Safari Special

Get on 20–10 meters with this portable, inexpensive, and easy to build vertical dipole.

by Jay Latham N4UQT

Do-it-yourself antenna projects are technically and financially feasible for most hams—they're the mainstay of amateur construction. Here's a simple 10 meter vertical dipole that started as an illustration in Doug DeMaw's *W1FB's Antenna Notebook*. The vertical dipole, an ordinary dipole whose elements are oriented vertically rather than horizontally, does not need a ground screen, but it's physically twice the height of a quarter-wavelength vertical antenna.

I needed an easily transportable 10 meter antenna that could be erected quickly in any location. Horizontal dipoles and other wire antennas are fine if sufficient space and tall trees are available as supports. But, if you don't know what the terrain is going to look like, you need a "put up anywhere" antenna.

W1FB's Antenna Notebook example shows wire dipole elements attached through stand-off insulators along a 16′ long, pressure treated 2″ x 4″ stud. The idea is straightforward and the antenna is easy to build, but it's rather heavy, and in my opinion has little eye appeal. In spite of that, it obviously fits the bill for Field Day. With this in mind, I set off to the local hardware store to gather materials for my version of the vertical dipole—the Safari Special.

Birth of the Safari Special

Hardware stores have always been a source of inspiration for me. Many of my roughly-conceived construction projects took definite shape as a result of the many components and materials on the store shelves.

I found what I needed in the corner of the stockroom: 8′ long sections of 1″ OD aluminum tubing, just waiting to be fashioned into a 10 meter antenna! The rest of the project came to me as I carried the tubing toward the checkout counter. Why not slide the tubing over ⅞″ wooden dowels, making the antenna virtually self-supporting? I bought two dowels, one for the center support of the upper and lower elements, and the other as an insulating base support for the entire antenna.

Feedpoint of the Safari Special vertical dipole. The wooden dowel has been painted to protect it from the weather.

Easy Tear Down/Put Up

The dowels are 3′ long, fit neatly into the aluminum tubing, and are easily removed for disassembly and transportation. Sand the dowels and spray them with acrylic enamel or some other nonconductive waterproofing material before final assembly, to prevent the wood from swelling and becoming stuck in the tubing. I also plug the open end of the upper element to keep water out.

Slip the aluminum elements onto the center dowel to a depth of approximately one foot, on each end of the dowel. This one-foot separation between the upper and lower elements provides enough space between the legs of the dipole to adjust the antenna to resonance before attaching the coax connector.

To tune the antenna to resonance, slide the dipole elements closer together or farther apart until you achieve a minimum SWR. Once you achieve resonance, secure the aluminum elements to the dowels with ½″ long No. 3 wood screws, right through the metal and into the wood.

The remaining hardware includes two 9″ lengths of No. 6 bare copper wire for connecting the antenna elements to the coax connector, 1-½″ stainless steel hose clamps to hold the copper wire tightly to the elements, and a simple bracket (made from a ceiling light fixture) to serve as a mount for the coax connector.

On Safari

I mounted the first Safari Special at my QTH with an inexpensive chimney mount. A second Special was attached to the top of an 8′ high, free standing 4″ square post in a friend's backyard. In other locations (where there aren't any chimneys, pipes, or posts), I set up the antenna in the sand, dirt or rocks, and guyed it at center with heavy duty

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The Uniden 800XLT receives 40 channels in two banks. Scans 15 channels per second. Size 9¼" x 4½" x 12½." If you do not need the 800 MHz. band, a similar model called the **BC 210XLT-T** is available for $178.95.

Bearcat® 145XL-T

List price $189.95/**CE price $94.95/SPECIAL**
10-Band, 16 Channel • No-crystal scanner Priority control • Weather search • AC/DC
Bands: 29-54, 136-174, 406-512 MHz.
The *Bearcat* 145XL is a 16 channel, programmable scanner covering ten frequency bands. The unit features a built-in delay function that adds a three second delay on all channels to prevent missed transmissions. A mobile version called the **BC560XLT-T** featuring priority, weather search, channel lockout and more is available for $94.95. CEI's package price includes mobile mounting bracket and mobile power cord.

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List price $599.95/**CE price $299.95/SPECIAL**
10 Meter Mobile Transceiver • New Features
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CIRCLE 121 ON READER SERVICE CARD

monofilament fishing line.

If possible, bring the feedline away from the antenna at a right angle for at least one wavelength. This is supposed to help prevent the coax from distorting the antenna's omnidirectional radiation pattern. (I have noticed no performance problems, however, with bringing the coax off at angles somewhat less than 90 degrees.)

I built the first Special while still a Novice operating solely on 10 meters, over a year ago. I was delighted to find out, now that I have the General ticket, that a Versatuner 901-B allows me to use the antenna on all bands 20 through 10, and I have the log entries to prove it! Entries include contacts with Japan, Alaska, Sweden, Brazil, Yugoslavia, Guyana, and many spots in between. Some of my buddies have called it the world's ugliest ham antenna, but the bottom line is: It works! I've used it with great success atop mountain ridges and on the seashore, as well as at home. This neat five-bander (20, 17, 15, 12, and 10 meters) is easy to transport by auto or boat, and takes little time to assemble and put on the air. It's also inexpensive—you can build it from readily available hardware for about $20. 73

Readers may reach the author at: Jay Latham N4UQT, Sequence Chairman, Broadcasting, College of Journalism and Mass Communications, University of South Carolina, Columbia SC 29208.

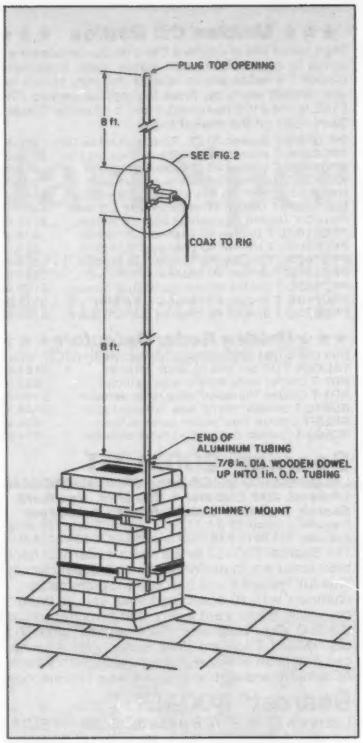
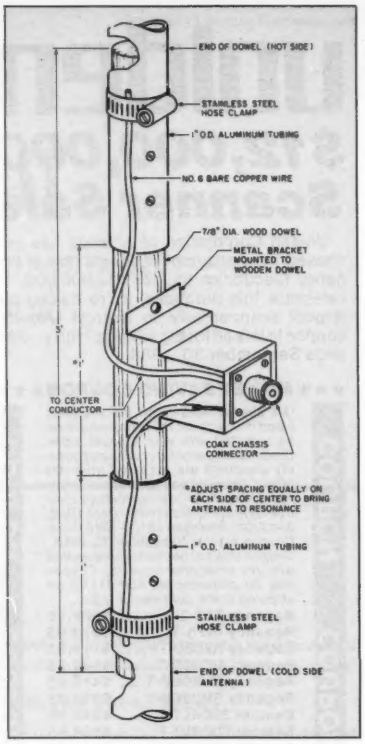


Figure 1. The Safari Special, mounted on a chimney.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COAX CHASSIS CONNECTOR
*ADJUST SPACING EQUALLY ON EACH SIDE OF CENTER TO BRING ANTENNA TO RESONANCE
1" O.D. ALUMINUM TUBING
STAINLESS STEEL HOSE CLAMP
END OF DOWEL (COLD SIDE ANTENNA)

Figure 2. Close-up of the Safari Special center portion, showing connection details.

Continued from page 42

At (c), a half-wavelength radiator is end-fed using a collinear length of open-wire line or "twin lead." A tuner must be at the transmitter end of the line. This antenna is in fact a Zeppelin or "zepp" stood on end. Cut the vertical radiator to as close to ½ wavelength of the operating frequency as possible. Ideally, bring the feedline away collinearly with the radiator for at least ¼ wavelength, in order to minimize feedline radiation.

At (d), you find an alternative method of feeding the vertical "zepp." The stub of parallel-wire line is ¼ electrical wavelength. The lower end is short-circuited, and a coaxial line connects about 1.6 of the way up from the bottom. Adjust the exact tap point for the lowest SWR on the coaxial line at the desired operating frequency. This antenna is sometimes called a J-pole because of its shape.

Again, though, radials enhance the operation of even these antennas. Add them at the bottom end of the half-wave or ⅝-wave radiating section, and you'll realize a gain of about 3 dB at low angles (that is, in the horizontal plane) in all directions, as compared to any of these antennas operated over poorly conducting soil with no radials. This doesn't affect the antenna's efficiency, just the principal radiation angle, due to the phase addition of the signal from the actual radiator and its image, reflected by the ground plane. The 3 dB gain is derived at the expense of power radiated at higher angles.

There's More to It than 1:1 SWR

Shorter radiators are often used at 80 and 160 meters with inductive loading. The main problem with short radiators is in getting high efficiency. The radiation resistance drops very quickly as a radiator becomes shorter than ¼ wavelength.

For example, at 160 meters, a 26-foot vertical is 0.05 wavelength electrically, or 18 degrees of phase. Interpolating Figure 2b, we find the radiation resistance to be about 1.5Ω. This holds true no matter how much wire there is in the tuning or loading coils. If there is no loss resistance, this antenna displays a purely resistive impedance of 1.5Ω at resonance; this mandates using a matching transformer for a good SWR using 52Ω feed cable, and ground loss must be minimized by an extensive system of radials.

Suppose we build an inductively tuned short vertical of this height for 160 meters and find that the SWR is 1:1 with RG-8/U coaxial cable at 1.800 MHz. We would be delighted at our good fortune until we figure the antenna efficiency:

$$R_T = 52\Omega$$
$$R_R = 1.5\Omega$$

$$\text{Eff}(\%) = 100(1.5/52)$$
$$= 2.9 \text{ percent}$$

In other words, for every 100 watts of actual power reaching the feedpoint, only 2.9 watts is radiated, while 97.1 watts is used up in heating the Earth! There is absolutely nothing we can do to increase the radiation resistance of an antenna except to make it longer physically in terms of the portion of a free-space wavelength that it spans.

Don't be discouraged from using short verticals—they work well when you optimize their efficiency via dropping the ground resistance. Recognize though that there is a limit to how short you can make a "short" radiator without some sacrifice in efficiency.

Tune in next month for Part II of this vertical antenna tutorial, where I discuss tuning coils and traps, useful bandwidth, interference, and low band DX considerations! 73

Stan Gibilisco W1GV can be reached at 871 S. Cleveland Ave., St. Paul, MN 55116.

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2.000	115	35.1
3.500	65.7	20.0
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7.000	32.9	10.0
7.300	31.5	9.60
10.100	22.8	6.94
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28.000	8.21	2.50
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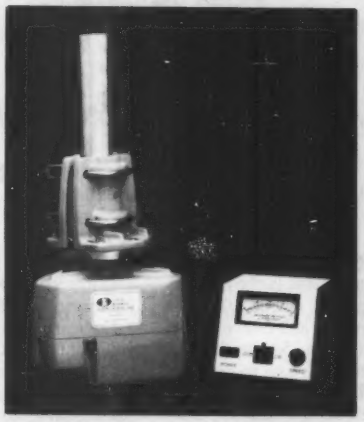

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Beefing Up the Uniden and the HTX-100

Give these popular rigs more punch.

by M. T. Stacey KC4HGH

The Uniden HR2510 and the HTX-100 have made a big splash in the amateur market. These $250–300 mobile 10 meter rigs are great performers, and fit in many of today's smaller cars. With 25 watts fed to a properly tuned antenna, it's easy to work the world, thanks to Cycle 22.

Even with the great sunspot activity, however, there are lots of other folks running much more power, and it can sometimes be tough to compete with them. I felt I needed more "oomph" to my signal.

Souping Up the Uniden

I didn't want to hook up an external amplifier, due to the severe lack of space in my sub-compact. So the rig went up on the bench for a tune-up. Although I modified the HR2510, this article also covers details on modifying the HTX-100.

I turned up the ALC, and reset the bias of the final and driver. Back to the mobile it went, with only *slightly* better results. Then I sat down with a couple of references, and decided to experiment on the RF output strip itself, since I've had good luck in this area with similar power modifications in some CB sets converted to 10 meters. Since Novices and Technicians are allowed 200 watts power out in the 10 meter voice band, it was worth a try.

In looking up the specs on the final transistor, an MRF477, you'll notice that it's rated at 40 watts PEP. If you crank the ALC all the way up and install a power mike on these rigs, you can overdrive them. Even with the stock mike, peaks can reach 55 watts. I set out to come up with a "beefier" setup for the RF output section of these radios.

The Mod

Just replacing the MRF477 with an MRF497 solves the overdrive problem, but still gives you no more power than before, so extra drive is needed. Looking "earlier" in the RF strip, you'll find a 2SC2086. Replace it with an ECG340, which provides more gain. Please note that the pinout of the ECG340 is exactly opposite of the 2SC2086!

Comparing the MRF497 to the MRF477, you will find that both have the same pinout, but the specs show the MRF497 to be a low-band FM transistor, which is rated at 40 watts RMS from 25 to 50 MHz, and is more efficient in the lower end of its range. This is ideal for hamming on 10 meters.

I tried several different transistor/driver combos, but experimentation showed the ECG340 and the MRF497 to be the best combo. The HR2510 and HTX-100 have non-tunable RF final sections, which restrict the number of useful combos.

After replacing these two transistors, and a few capacitors on the bottom of the board, and retuning/rebiasing the RF section, you will find that the rig's power out has greatly increased! Please refer to the tables for proper parts and tune-up data.

Results

All readings were taken on a power meter, using a 1 kHz test tone, with the signal fed into a dummy load. Normal voice (mine, at least) stays in the 60–65 watt range. The new PEP/Carrier ranged from 75W/11W at 28.075 MHz, to 90W/12W at 29.7 MHz.

For lower SSB power, I simply punch in the MIC GAIN button, which approximately halves the output power. The carrier power stays the same, but I suspect you could increase it to 20 watts for FM operation, with no detrimental effects. For the HTX-100, an internal adjustment and an external control governs low power output.

You might think this power modification would run into big bucks, but not so. My only investment is $25 and a little time on the bench. Best of all, I've kept it in one package!

Before the mod, using my peaked-out HR2510, I noticed the heat sink was almost too warm to touch; now, after the power mod, the heat sink only gets moderately warm, attesting to the fact that the transistors are not as stressed as before. Also, folks that knew my rig "before" and "after" have noticed the extra power punch and clean audio quality. I'm satisfied!

Resources

For proper alignment procedures, consult the service manuals for the HR2510 and the HTX-100. They will also give you the proper information in reference to parts locations, maintenance setups, etc. For the Uniden HR2510, contact Uniden Parts Dept., 9319 Castlegate Dr., Indianapolis IN 46256. For the Realistic HTX-100, contact your local Kadio Shack, or Tandy National Parts, 900 North Side Dr., Fort Worth TX 76102.

For the ECG340, contact your local ECG Sylvania dealer; price is about $3.40 plus tax. The MRF497 is available through RF Parts, 1320 Grand Ave., San Marcos CA 92069, telephone (800) 854–1927 for orders *only*; price is $14.95 plus $5 shipping.

I'd like to hear from other operators experimenting with the HR2510. Good luck! 73

M.T. Stacey KC4HGH, PO Box 907, Satsuma AL 36572.

Uniden HR2510/Realistic HTX-100

Power Modification Parts

Procedure	HR2510	HTX-100
Relocate capacitors to bottom of board	C112, C116	C117, C118
Replace 2SC2086D transistor with ECG340; note pinouts! (See note below.)	Q134	Q34
Replace MRF477 with MRF497	Q132	Q502
Set bias of MRF497 @80-85 mA, USB	VR112	VR11
Check output of radio with meter of at least 100W and dummy load; adjust ALC to peak with 1 kHz tone	VR104	VR5 (VR6 low pwr adj)
Spread coils for maximum power	L121, L123	L14, L16
Check AM/FM carrier level and adjust	VR107	n/a
Check CW power level and adjust	VR103	VR13

Pinouts of 2SC2086D and ECG340 are exactly opposite:
2SC2086D = BCE, ECG340 = ECB.

In the HTX-100, VR5 can be adjusted for maximum power output, and with front panel control pulled out, low power can be set with VR6.

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73 Book Reviews

Two Must-Adds for Your Library

Power supplies and microprocessors.

reviewed by Larry Antonuk WB9RRT

44 Power Supplies
for Your Electronic Projects
by Robert J. Traister and Jonathan L. Mayo
Published 1987 by TAB Books, Inc.
Blue Ridge Summit PA 17214-0850
Softbound, 7" x 9"
Price: $15.95

Just Right for Newcomers

44 Power Supplies for Your Electronic Projects is one of five new TAB books that make up the "Hobby Electronics Series." The series is specifically designed for the newcomer. Beginning books tackle basic electronics, schematic interpretations, and troubleshooting. Once the Novice has progressed through these topics, he can attempt various projects and hopefully power them with a supply from *44 Power Supplies*.

Chapter two plunges into a general discussion of power supplies. Once the operation of the supplies is covered, chapter three explains the function of each device used in a supply. Chapter four follows with a detailed explanation of voltage regulation.

Chapter five is an interesting discussion on "Obtaining and Referencing Components." This is one area that is all too often neglected. How does one come up with parts? For those readers new to the electronics scene, this short chapter will provide a wealth of information. Where do I buy parts? Where can I get them for free? How do I go about creating the famous "junk box?" (Or getting someone else's junk box for nothing!) Once I've ripped apart that old TV chassis, how do I determine what to keep? All the answers are there, perhaps never before in print!

Once all the groundwork has been laid, chapter six (about half of the book) gives the information necessary to build any of the forty-four supplies. Each project consists of a short description, a clear schematic, and advice on how to deal with any irregularities of the circuit. The circuits range from simple half-wave supplies to switching regulators. One bright spot is the inclusion of several metering "projects." Gee, I need a one amp meter, and I've got this 250 mA meter. . .how do I wind the shunt resistor?

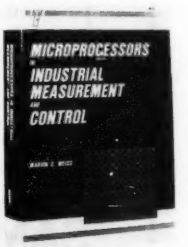
"The book is written at a basic level, perfect for the beginner. The reader is given enough electronic theory to understand the concepts explained throughout the book."

Overall, *44 Power Supplies for Your Electronic Projects* is an excellent book. A good introduction to power supplies for the Novice, and a book that is liable to find a permanent spot on the workbench bookshelf.

Microprocessors in
Industrial Measurement and Control
by Marvin D. Weiss
Published 1987 by TAB Books, Inc.
Blue Ridge Summit PA 17214-0850
Hardbound, 6" x 9," 436 pages
Price $44.95

Getting the Inside Story

The use of computer control in manufacturing is another of those disciplines that seems to be shrouded in mystery. Only the elite groups that actually get to work with the stuff, or maybe those folks with appropriate doctorates, *really* know what's going on. For those of us with just an abnormal interest in electronics and machines, Marvin Weiss has gone a long way toward dispersing the fog.



Starting with a discussion on manufacturing processes and measurement techniques, the book discusses various transducers and sensors. This gives the uninitiated reader a foundation in industrial processes that makes the rest of the book understandable. Various measurement systems are explained, followed by a complete history of digital automation and computerized process control. The introduction of computerized control is discussed, which leads into the microprocessor and its various applications. Complete systems are explained using microprocessors, PCs, or mainframes. The book closes with Weiss doing some crystal ball gazing on what lies down the road in the field of computer control.

The only negative point to the whole book concerns the diagrams. These are the basic low-resolution computer graphics drawings that are usually seen on yard sale announcements. I feel that this is not adequate for a book of this caliber, even if the author was using them to make a point.

The author claims some thirty-plus years in the digital systems field, which is obvious from the feeling of history one gets from the text. This makes for a simply enjoyable book. Good reading even if the user is only remotely interested in industrial control. It gives you a great introduction to the world of microprocessors, items that are quickly becoming a standard feature in all new ham gear. 73

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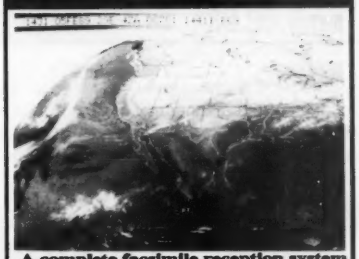

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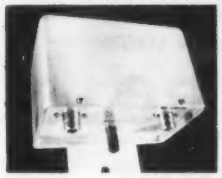

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73 Review

by T.S. Rowinski KA1MDA

Uniden Bearcat BC100XLT Hand-Held Scanner

Taking it to the streets . . .

Uniden Corporation of America
4700 Amon Carter Blvd.
Ft. Worth TX 76155
Telephone: (317) 842–2483
Price Class: $380

My old scanner did just about everything I wanted it to do. It could not break free, however, from the all-important power outlet. If I wanted to listen in the field or on the go, the choice was simple—either get a very long extension cord, or break down and invest in a hand-held unit. I chose the latter.

After looking over the models available, I decided on the Uniden-Bearcat BC100XLT. This unit features 100 channels, 11 bands, and a rechargeable NiCd pack. It also includes a plug-in charger and protective carrying case.

The Uniden-Bearcat BC100XLT measures 2.75″ wide, 8″ high, 1.5″ deep, weighs approximately one pound, and is finished in a dark gray plastic case. The layout is clean and sensible. Volume and squelch controls are located on top of the unit, along with the antenna and earphone connectors. The front of the unit contains the LCD display window, keyboard, and speaker. A NiCd battery pack slides onto the bottom of the radio.

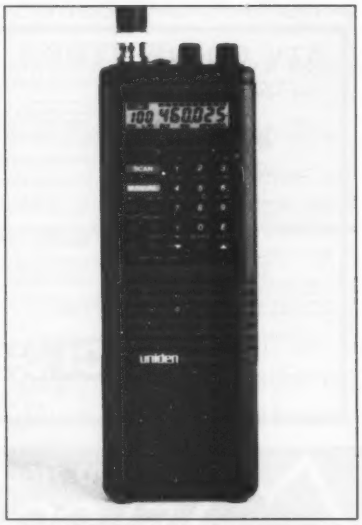
Internally, the radio is well organized and assembled, and uses mainly surface-mount technology. The LCD, CPU, and keyboard comprise one circuit board, and the entire RF circuitry is mounted on the other board. They separate easily for convenient servicing.

Coverage

The receiver covers 29–54, 118–174, and 406–512 MHz. This includes the 10m, 6m, 2m, and 70cm ham bands, as well as the VHF-LO, VHF-HI, UHF, and UHF-T bands (see table). The mode for all bands is NBFM, except for 118–136 MHz, which is AM. For ham use, this rig is especially useful for monitoring 2m and 10m FM activity.

Programming features include 100 channels arranged in 10 banks, priority channels, weather scan, frequency search, channel lockout, scan delay, key pad lock, and a low-battery indicator. The unit also sports a half-hour memory backup.

All of the controls on my unit functioned flawlessly. The volume and squelch controls operated smoothly, with just enough drag to prevent accidental rotation. The buttons on the keypad, though, are on the small side. If you have large fingers, a pencil eraser would make programming the 100 channels much easier and faster. Luckily, the most often used keys for normal operation are also the largest, so once the unit is programmed, large fingers are no problem.



The Uniden BC100XLT Bearcat scanner.

On the 22-key keypad, there are only nine double function keys, and these are the digit keys. This serves to really minimize keyboard confusion. The keys themselves are actuated by a semi-soft rubber overlay, and although the keys provide some tactile feedback, the feel was somewhat soggy. The keys are labeled with white and light gray numerals on a black background. All are easily readable in daylight, although the ones marked in gray become increasingly difficult to read as light decreases. Fortunately, the most-used keys are white.

Readout

The LCD display is simple and easy to read, even from an angle. For night viewing, the BC100XLT features an excellent display light, which evenly bathes the LCD display in a soft, green light, bright enough for viewing even from a distance. The only drawback is that the clear plastic lens covering the LCD display appeared susceptible to scratches and hazing. Readability in bright sunlight is on a par with the ICOM ØX HT series.

Although the radio itself has no belt clip, there's a belt loop on the carrying case. Congratulations to Uniden for offering a hand-held scanner with a removable NiCd battery pack as a standard feature! Being able to swap packs in the field is a great convenience. It's about time the scanner manufacturers took a hint from the ham hand-held market! Extra packs are available as accessories from Bearcat.

Programming the BC100XLT

This is very easy to program, although some of the key sequences are a little different from other scanners I've used. Memory entry is uncomplicated, requiring only memory channel <ENTER>, and then frequency dialing <ENTER>. Two minutes with the owner's manual, and operation was a snap! The scan and search functions, as well as the scan-delay and lock-out features, all work as expected. (The search function is also called programmed scan, in which a piece of spectrum between two specified bounds is scanned.)

There were even a few pleasant surprises! Should you attempt to enter a frequency into memory that has already been entered on a different channel, the radio will not only alert you of this, but also tell you the other channel number. The priority feature scans the first channel of each active bank every two seconds, providing up to 10 priority channels. Another excellent feature is the weather search function. With the push of one key, the radio scans all assigned NOAA weather frequencies. This allows for easy, up to date weather info in any area without having to tie up memory space or the normal search function. Other nice touches include one-button lockout of any channel or bank of frequencies, direct access to any channel without having to step through endless banks of frequencies, and a scan delay function that can be activated individually for each channel.

I evaluated the receiver section of the Uniden BC100XLT using two methods. First, I used the radio extensively for 10 days to form a subjective opinion of its performance. I then put the unit through its paces on the test bench to see how the numbers compared to real-world performance.

Field Evaluation

The first thing that caught my attention was the almost total absence of "birdies,"—internally generated spurs that stem from a variety of sources within the rig, such as the microprocessor, local oscillators, and mixers. Receiver sensitivity and selectivity are more than adequate, yet I never experienced front-

Continued on page 79

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PA-20 220 MHz POWER BOOSTER (8 X power gain) Fully wired & tested $69.95

Complete kit, SG-7

PERSONAL SPEED RADAR

$89.95

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RADIOS

20, 40 & 80 METERS HAM RECEIVERS

Sensitive all mode, AM, CW, SSB receivers for 3.5—4.0 or 7.0—7.5 MHz. Direct conversion design using NE602 IC as featured in QST and ARRL handbooks. Less than 1 μv sensitivity, varactor diode tuned, 50 mw audio output. Runs on 9VDC, has RF gain control. This kit is very easy to build, lots of fun and educational—ideal for the beginner or the old pro. The optional matching case kit features a rugged ABS plastic case with screened graphics. Included are machined aluminum knobs for a well-finished professional look.

20 MTR receiver kit HR-2 **$24.95** | 40 MTR receiver kit HR-4 **$24.95** | 80 MTR receiver kit HR-8 **$24.95** | Receiver case CHR **$12.95**

QRP TRANSMITTER KITS, 20, 40 & 80 METERS

Operate a mini ham shack. These little CW rigs are ideal mates to our 40 and 80 meter receivers. Features include smooth variable tuning, one watt output and excellent keying characteristics. Runs on 12 VDC and is VSWR protected. See how far you can stretch your signal with one of these mini rigs. Optional ABS cases are available.

20 MTR QRP Kit QRP-20 **$29.95** | 40 MTR QRP kit QRP-40 **$29.95** | 80 MTR QRP kit QRP-80 **$29.95** | Case kit CQRP **$12.95**

AIRCRAFT RECEIVER KIT

Hear exciting aircraft communications—picks up planes up to 100 miles away. Receives 110—136 MHz AM air band, varactor tuned superhet design with AGC, ceramic filter and adjustable squelch. Runs on 9V battery, 50 mw audio output, 1 μv sensitivity. Optional matching ABS plastic case lets you take it anywhere, features screened graphics and machined aluminum knobs for a real professional look. Compact—great for airshows or for just plain hanging around the airport.

Complete kit, AR-1 **$24.95** | Receiver case kit, CAR-1 **$12.95**

SHORTWAVE RECEIVER KIT

A fantastic receiver that captures the world with just a 12" antenna! Receives 4—11 MHz in 2 MHz bands, varactor tuned, superhet design with AGC, RF gain control, and 50 mw audio output. Uses new Signetics mixer chip for less than a microvolt sensitivity, runs on 9V battery. This is a fascinating scout, school or club project, and will provide hours of fun even to the most serious DX'er. Add the optional case kit and you have a real nice looking shortwave set.

Complete kit, SR-1 **$24.95** | Receiver case kit, CSR-1 **$12.95**

PACKET RADIO

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2 MTR kit FR-7 **$29.95** | 10 MTR kit FR-10 **$29.95** | 220 MHz kit FR-20 **$29.95** | Receiver case kit CFR-7 **$12.95**

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A sensitive all purpose preamp, ideal for scanners, TV sets, VHF, UHF rigs, counters, etc. Features low noise, 4 db NF, 20 db gain, 100 KHz—1 GHz operation. Runs on 9—12 VDC, 50 ohms input.

Complete kit, SA-7 **$14.95**

LIGHT BEAM COMMUNICATORS

Transmits modulated infrared light up to 30 feet without lenses, up to 1/4 mile using lenses. Uses 30 KHz carrier for hum-free operation, transmits thru windows, etc. Ideal for "bugs" or listening to IR remote controls. Transmitter has sensitive mike input, receiver uses PIN detector and drives speaker output. Units operates on 9—12 VDC.

Transmitter kit, LB-6 **$8.95**

Receiver kit, LB-5 **$9.95**

HIGH POWER FM WIRELESS MIKE

A high power unit that will transmit up to 1/2 mile to any FM broadcast radio. Sensitive input accepts any type of mike, will pick up normal voices 10 feet away using the available mini-electric mike cartridge. Operates on 9—12 VDC

FM-4 kit **$12.95**

Sensitive microphone cartridge **$2.95**

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40 WATT 2 mtr PWR AMP Simple Class C power amp features 6 times power gain 1 W in for 6 out, 2 W in for 15 out, 5 W in for 40 W out. Max output of 50 W, incredible value, complete with all parts, less case and T-R relay.

PA-1, 40 W pwr amp kit **$27.95**

TR-1, RF sensed T-R relay kit **6.95**

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VOICE ACTIVATED SWITCH Voice activated switch kit provides switched output with current capability up to 100 mA. Can drive relays, lights, LED or even a tape recorder motor. Runs on 9 VDC.

VS-1 KIT **$6.95**

VIDEO MODULATOR Converts any TV to video monitor. Super stable, tunable over ch 4-6. Runs on 5-15V accepts std. video signal. Best unit on the market! Complete kit. VM-7 **$12.95**

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BL-1 Kit. **$3.95**

MAD BLASTER Produces LOUD ear shattering and attention getting siren like sound. Can supply up to 15 watts of obnoxious audio. Runs on 6-15 VDC

MB-1 Kit **$4.95**

UNIVERSAL TIMER Provides the basic parts and PC board required to provide a source of precision timing and pulse generation. Uses 555 timer IC and includes a range of parts for most timing needs.

UT-5 Kit **$5.95**

WHISPER LIGHT An interesting kit, small mike picks up sounds and converts them to light. The louder the sound, the brighter the light. Includes mike, controls up to 300 W, runs on 110 VAC.

WL-1 Kit **$6.95**

FM WIRELESS MIKE Transmits up to 300' to any FM broadcast radio, uses any type of mike. Runs on 3 to 9V. Type FM-2 has added sensitive mike preamp stage.

FM-1 Kit **$5.95**

FM-2 Kit **$7.95**

SIREN Produces upward and downward wail. 5 W peak audio output, runs on 3-15 volts, uses 3-45 ohm speaker.

Complete kit, SM-3 **$3.95**

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BN-9 Kit **$5.95**

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TB-6 Kit **$5.50**

TB-6 Assy. **$9.95**

TELEPHONE TRANSMITTER Low cost with professional performance. Features include; self phone line powered, tunable from 76 to 100 MHz, polarity antisensitive, compact size (1⅞" x 1¼"), easily installs anywhere on the phone line or inside the instrument itself.

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FM MINI MIKE A super high performance FM wireless mike kit! Transmits a stable signal up to 300 yards with exceptional audio quality by means of its built in electret mike. Kit includes case, mike, on-off switch, antenna, battery and super instructions. This is the finest unit available.

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SPEECH SCRAMBLER Communicate in total privacy over your telephone or radio. This scrambler kit features full duplex operation using frequency inversion. Runs on a 9 volt battery. Both mike and line or speaker output/inputs. Easy to connect to any radio—telephone use requires no direct connection! Easy to build, uses IC DBM circuitry . Can also be used to descramble most com. scramblers.

Complete kit, SS-7 **$29.95**

Case kit, CSS-7 **12.95**

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CT-90 9 DIGIT 600 MHz

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CT-125 9 DIGIT 1.2 GHz

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Tilt bail for CT-70, 90 & 125	3.95
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MODEL	FREQ RANGE	SENSITIVITY	ACCURACY	DIGITS	RESOLUTION	PRICE
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CT-90	10 Hz-600 MHz	< 10mv To 150 MHz < 150mv To 600 MHz	1 PPM	9	0.1Hz, 10Hz, 100 Hz	169.95
CT-50	5 Hz-600 MHz	LESS THAN 25 mv	1 PPM	8	1Hz, 10Hz	189.95
CT-125	10 Hz-1.25 GHz	< 25mv @ 50 MHz < 15mv @ 500 MHz < 100mv @ 800 MHz	1 PPM	9	0.1Hz, 1Hz, 10Hz	189.95
CT-90 WITH OV-1 OPTION	10 Hz-600 MHz	< 10mv To 150 MHz < 150mv To 600 MHz	0.1 PPM	9	0.1Hz, 1Hz, 10Hz	229.90

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Six Meter Activity

Without going to "blue light" and laser topics, let's leave high microwave frequencies a bit and look at 6 meter activity. I will not forget laser activity, as I have picked up some high-power lasers, and when we've had time to experiment, I'll let you know what's going on.

The 6 meter band is the first really large frequency allocation that we have moving up frequency on the spectrum. It occupies 4 MHz, from 50 to 54 MHz. The top 2 MHz, from 52 to 54 MHz, is allocated to repeater use, with 1 MHz splits, and 52.525 is reserved for a national simplex calling frequency for FM (see the Table).

During most contests, the frequencies of prime interest are SSB on 50.100 and 50.300 MHz. Most weak signal work goes on at the lower edge, just below the 50.110 calling frequency. When the band really opens up with good F2 propagation, the entire SSB portion of the band is swamped with an unbelievable number of calling stations. During periods of poor propagation (which is most of the time), however, you can call until you're blue in the face and only get locals (maybe). Therefore, this band has beacons authorized to give you information on band quality.

Six Meter Beacons

Many 6 meter stations use beacon signals by running all the time so they won't miss a band opening when it comes. The beacon is like a bell on the end of your fishing pole to let you know when you've got a bite. The band opening during the 1959 sunspot cycle was so good it gave worldwide coverage on 6 meters in a near bedlam crunch of signals. Most people did not believe it was a VHF frequency.

The challenge on 6 meter operation comes from the time and dedication you must put into doing something that is not easily picked up or bought. It takes work, and awards, such as WAS (Worked All States), await the patient 6 meter amateur. Some people now work grid squares on this band.

Tropospheric and F2 Propagation

The normal horizon for VHF frequencies is about 300 miles, with occasional tropospheric refraction extending it to about 800 miles. Sporadic E openings are radio signals reflected off charged particles in the E layer, which is about 30 to 70 miles above the earth. The E layer gives signals a range of up to 1500 miles for a single bounce, to 2500 miles on a double bounce.

In F2 propagation, signals bounce (reflect) off a layer near the top of the ionosphere, about 200 to 300 miles up. These signals, returning, create much interest because paths of 2000 miles are common. Double-hop paths can be as long as 10,000 miles with very good signal quality.

This season promises to be one of the best on this interesting frequency band in many years. That makes getting your 6 meter equipment dusted off and back in operating shape a prime goal, as I am presently doing. The predictions point to propagation as good as that in 1959, which was absolutely outstanding.

Switching Circuit —6 Meter Preamp

The equipment for 6 meter operation at my station is an ICOM IC-551 10W transceiver and a 4-element beam antenna about 15 feet above roof level. Though modest by some comparisons, it has performed well. I would have liked the higher power IC-551D 80W transceiver, but I couldn't swing the deal at the time. In building up the station, I tried various preamps and even built my own high power amplifier. In switching the units together with my transceiver, I found the switching circuit to be rather "bulletproof."

This preamplifier, a basic design, uses a 5W dissipation high-power 2N5109 transistor, normally used in cable TV amplifiers. These are nearly burnout proof. The 2N5109 gave a measured noise figure of less than 1.8 dB, more than adequate for 6 meter activity.

I found that the more sensitive devices, like GaAsFETs, are prone to relay switching problems and rear-end blowout when you try to push your transmitter through the receive device for a few milliseconds during the receive/transmit change-over. In a radio like the ICOM IC-551, pin diodes do the switching internally, and this is fast compared to relay switching schemes. My transceiver didn't allow power amplifier switching, so I came up with this simple switching circuit to control my home-brew final amplifier.

Fortunately, the IC-551 has RCA connectors on the back for hooking up the pre-amp to the radio's internal switching circuitry. This simplified things; I only needed an external circuit to key the power amplifier on transmit. I did not want to use a power detect circuit, or "tranx circuit," as they are called. I wanted a positive control circuit, and I came up with a good one (see Figure 1).

You can use this circuit on any other radio with a positive voltage on transmit, to turn on the 2N2222 transistor which activates the relay in its collector circuit. In receive or off, the line (base of transistor in Figure 1) is pulled to ground. The purpose of the isolation relay is to protect the radio and give a contact for keying of external control high current relay. If for some reason there is a failure in the switching circuit, the only thing that will happen is that the power amplifier will fail to key, allowing the transceiver's own reduced drive level (about 2–4 watts) to flow to the antenna through the non-operated change-over switch.

The ICOM IC-551 rear connector has all the pinouts you need for control. You don't have to go into the radio and make modifications. According to the ICOM manual, the control voltage available on pin 6 of my ICOM is limited to 5 mA. Check your manual to determine what your limits could be, if any. To limit the current to 2 mA, I used an external resistor of 3.2k in addition to the internal 470Ω re-

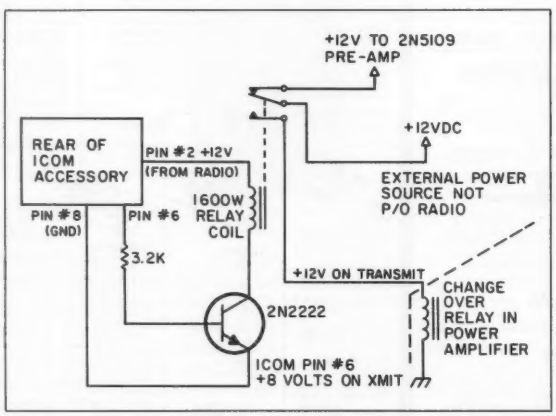

Figure 1. Circuit to control power amplifier switching with the IC-551.

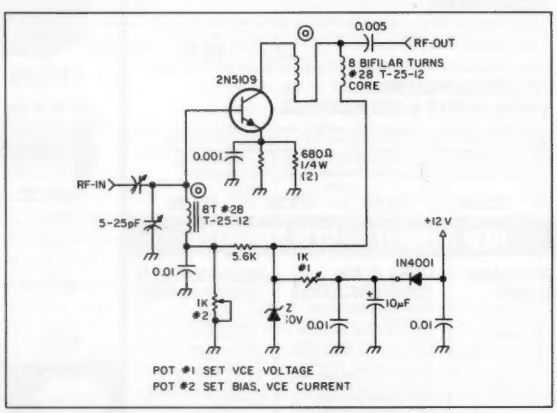

Figure 2. Preamplifier circuit for the 6m station described above.

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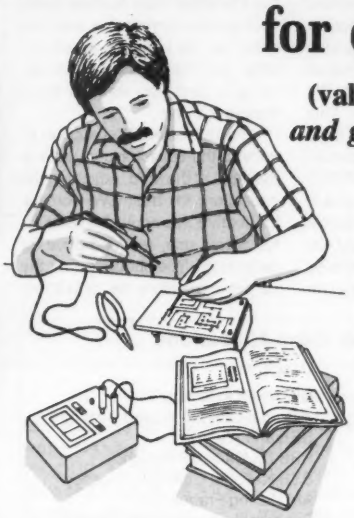

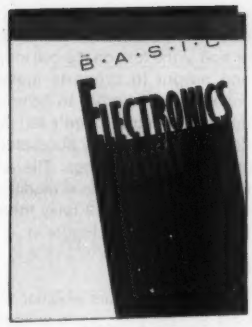

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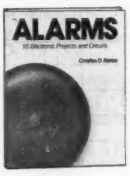

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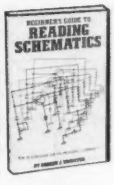

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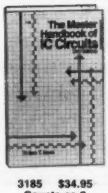

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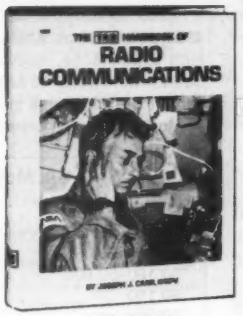

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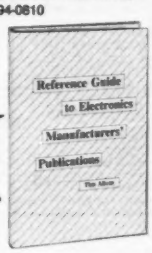

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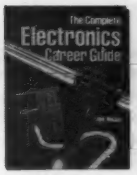

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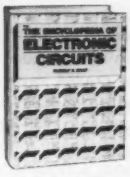

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sistor in the radio. This protects the radio circuitry from overcurrent at all cost, a good design point. The switch proved to be very reliable in many years of use.

Figure 2 shows the 6 meter preamp circuit, which I built in a small homemade PC board box for shielding. The transistor was placed in the center with a PC board partition separating the input and the output circuitry.

6 Meter Power Amplifier

See Figure 3 for the power amplifier and bias circuit. The power amplifier was constructed with a surplus transistor marked A50-12, an offshoot from one of the CB power amplifier crazes several years ago. Motorola lists an excellent replacement, MRF-492 (70 W 50 MHz), equivalent to the A70-12. The layout is straightforward; I mounted all parts on a printed circuit board, cutting the copper to form small squares or pads for mounting the components. The amplifier is operated in the linear mode with about 0.35 to 0.4 volts of forward bias supplied to the base of the transistor.

The bias circuit, comprised of a voltage divider made up of two 1Ω resistors, is simple. We limit current to a forward biased power rectifier with a 150Ω resistor, and take the resulting forward voltage drop of about 0.7 volts and apply it to the two 1Ω voltage dividers. This gives about 0.35 volts at the junction for the transistor base circuit.

I used ceramic trimmer ARCO 429 type capacitors, although any high capacitance, high current type will work well. The ARCO 429 capacitor is variable; it measured 100 to 450 pF on my capacity meter. When tuning the power amplifier up, check the bias to prevent the transistor from running away with excess current (not over 0.5 volts) on the base. At about 0.7 volts, you will turn on the transistor fully, and you want to avoid excess current!

When all tested OK, I applied 12 volts to the collector and drive to the input of the amp. Adjusting the capacitors for best SWR on the input drive was about 2.5 watts for full output use, reduced drive for initial tests. You should adjust the output capacitors for maximum output. I had to reduce the length or size of the turn on the coil input and output to properly match impedances, in order to achieve maximum output. Don't let the device become overly dissipated; use short key-up times. The antenna change-over is a modified standard DC type 12 relay modified for RF use (see Figure 4).

Six Meter Band Allocations

Frequency (MHz)	Usage
50.000–50.100	CW and Beacons
50.060–50.080	Automatically Controlled Beacons
50.100–50.600	SSB and AM
50.110	SSB DX Calling Frequency
50.200	SSB National Calling Frequency
50.400	AM Calling Frequency
50.600–51.000	Experimental and Special Modes
50.700	RTTY Calling Frequency
50.800–50.980	Radio Control (10 channels)
51.000–51.100	Pacific DX Window
51.100–52.000	FM Simplex
52.000–52.050	Pacific DX Window
52.000–54.000	FM Repeater and Simplex

From the Mailbox

Gary KE6CZ asks whether the Grid Square program is suitable for distances greater than local (USA) coordinates. On his Tandy 102, the program gives incorrect compass headings and erroneous nonlocal distances. Could there be a program error in calculating the compass headings? The mileages/distance came out fine for distances of up to 200 miles, but with longer distances, the errors increased.

On my Tandy 100 and a Kaypro computer, I tried the locations Gary was having trouble with, but they all came out properly. Data entry errors or something special to the Tandy 102 could be the problem. If any of you have information on the Tandy 102 with the

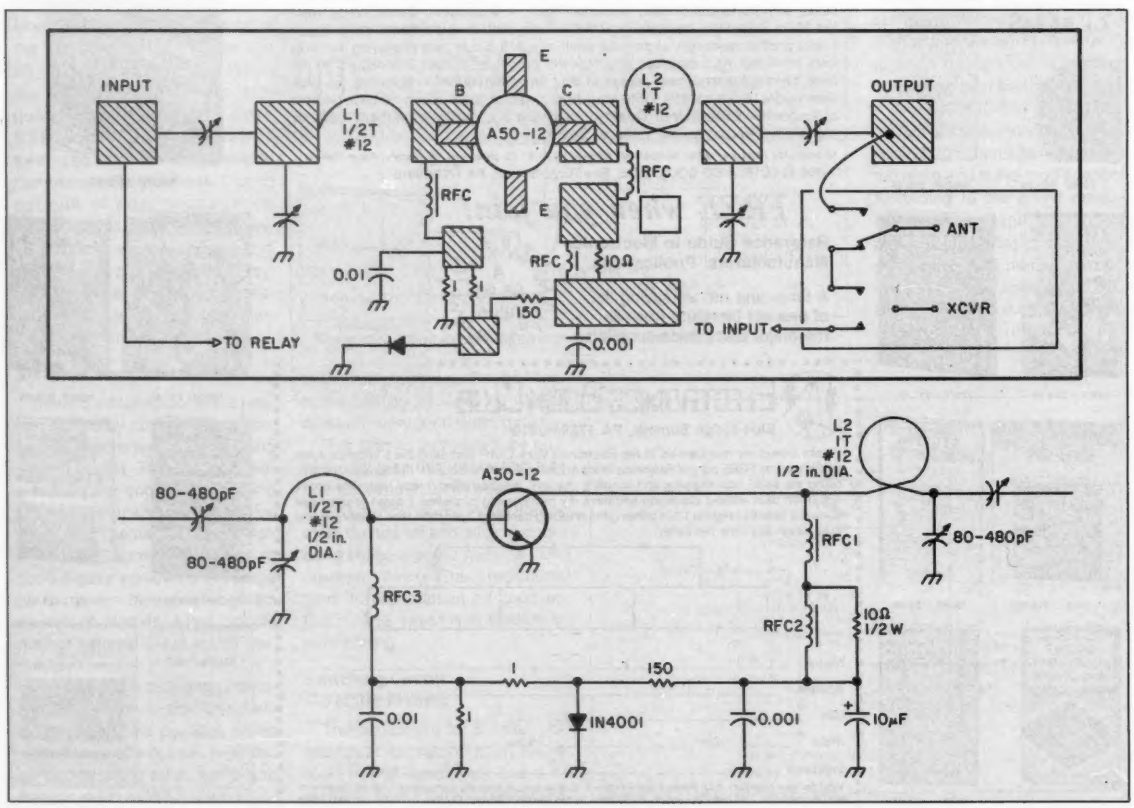

Figure 3. Power amplifier and bias circuit.

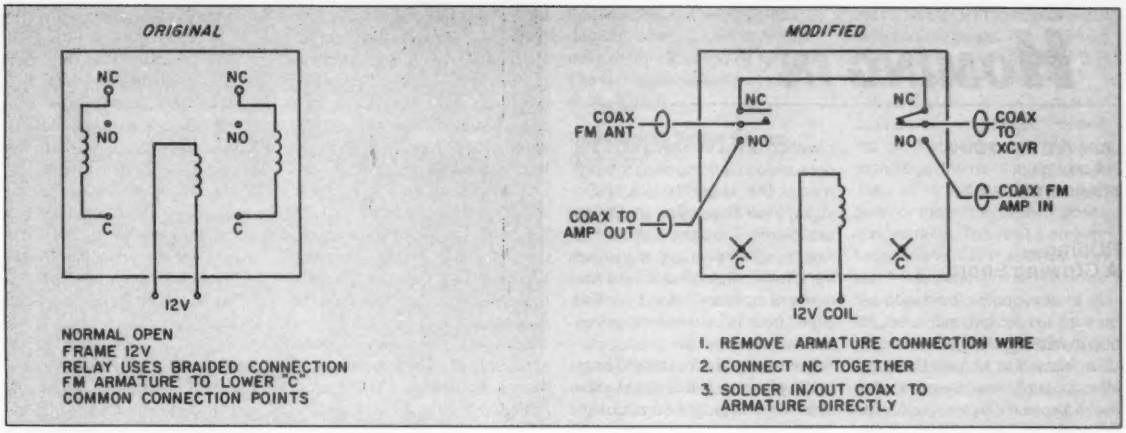

Figure 4. Antenna change-over circuit.

Grid Square program, let me know. Bruce KB4ZAX states he has it up and running on his Tandy 100, and he's eager to locate other programs he can use. He would especially like to find a logging program with a search feature for contest and Field Day operations.

Larry K1LPS is keeping me informed of activities in his neck of the woods in Vermont. Larry is quite active, presently working on several projects to use on bands up to 10 GHz, such as parobolic dishes for 2304/3456 MHz. He's also trying his hand at 10 GHz toward Canada, with Michael VE2DUB in Montreal from his 3300 foot location. VE2DUB is organizing 10 GHz activity in the Montreal area, and he should have a beacon up for testing 10 GHz equipment. Michael has an 18-inch dish, roof-mounted, with a penny feed. It's perforated to minimize wind loading.

By the way, shipping ham items to Canada can result in quite a tariff tax to the receiving party. But if the item is specified as an amateur transmitter or receiver, with the appropriate tariff number, such as 8525.39.10, which is a catch-all number, you can send the items duty free, incurring only local sales tax. You should obtain the tariff number that applies to your item.

Solfan News

It seems that many amateurs are having trouble locating 10 GHz Solfan microwave alarm devices. Recently, I received a letter from SHF Microwave Parts, 7102 W. 500, S. La Porte, Indiana 46350, informing me that they have a quantity of Solfan style units and other parts for 10 GHz operation available. Write for details.

Let me know what's happening in your area. I will be operating in the ARRL 10 GHz contest again this year, and I hope to see you there or on 6m. As always, I will be willing to answer questions relating to amateur microwave VHF/UHF. Please include an SASE for a prompt reply.

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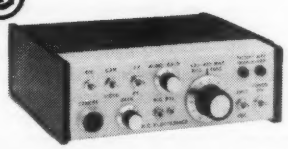

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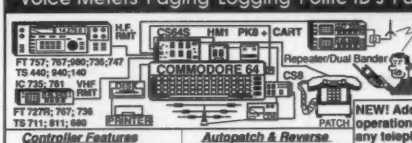

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RDFing—A Growing Sport

In recent months, the mail has brought letters and phone calls about RDFing from all over the USA, Hawaii to Maine, Canada, Malaysia, Italy, Iran, Sweden, and Brazil. I've had the pleasure of giving talks on ham RDF to about twenty clubs, and telling about it on a nationwide radio show. New hunt groups are forming constantly, and they're having a great time.

Homing In would like to hear about your hunts, too. So help fill my mailbox even more. Include an SASE, and I'll send you a bibliography of recent books and articles related to transmitter hunting.

What's a TDOA?

Until now, I've discussed only single-antenna RDF systems, such as yagis, quads, and loops. They're great for locating weak or strong signals of just about any mode when the transmitter power is steady. But sometimes the signal amplitude isn't constant. When the S-meter is bouncing around so much that you can't tell when you're pointing the beam or quad at the signal source, you know it's time for a different kind of RDF system.

Over the years, a number of RDF schemes evolved that ignore the ups and downs of the incoming signal. They all involve the use of multiple antennas and comparisons of the signal that the hidden T puts into each one.

Switched-pattern DFs (such as the L-Per and Happy Flyer) and ring antenna units (such as Adcocks and Dopplers) are examples of well-known multiple antenna schemes. I'll cover these in future columns. This month, we'll look at a system that has a simpler principle of operation—the time-difference-of-arrival, (TDOA) antenna system.

Figure 1 shows a simple TDOA array, consisting of two vertical dipoles at the ends of a horizontal bar, supported by a short mast. It's called a narrow-aperture TDOA because the dipoles are a half wavelength or less apart. The direction of the incoming signal is determined by comparing the signals at the whips. Note that the signal from Transmitter #1 arrives at Antenna A before it arrives at Antenna B. Conversely, the signal from Transmitter #3 arrives at Antenna B before Antenna A. The signal from Transmitter #2 arrives at both antennas simultaneously.

Some sophisticated military RDF systems use this TDOA principle to get highly accurate bearings at fixed-site radio direction finding (RDF) installations for the HF bands. Even the elevation angle of arrival above the horizon can be determined, giving an idea of the distance of skip-propagated signals. But resolving ambiguities, determining elevation, and achieving high accuracy in a non-rotating system requires at least three antennas and a large, fast computer for signal processing. We're talking megabucks, so that's not practical for ham radio use, at least not yet.

But there's a well-known characteristic of FM detectors that makes the rotatable TDOA array of Figure 1 a useful tool for VHF ham radio T-hunting with very simple signal processing. Feed the two antenna coaxes to an FM receiver through a selector switch, and then toggle that switch between the two antennas very rapidly, say 500 times per second. If the signals aren't arriving at both antennas at exactly the same time, there's an abrupt phase jump during switching, which the FM discriminator interprets as a frequency change.

Antenna switching occurs at an audio rate, so the apparent frequency change produces a superimposed tone on the received audio. The tone frequency remains constant at the switching rate, but the tone amplitude increases with the increasing phase difference between the signals arriving at the two antennas. The goal is to get a tone of minimum amplitude; this occurs when the antennas are equidistant from the signal source. At this point, the tone should disappear altogether. Other null patterns are possible using delay lines in individual antenna paths.

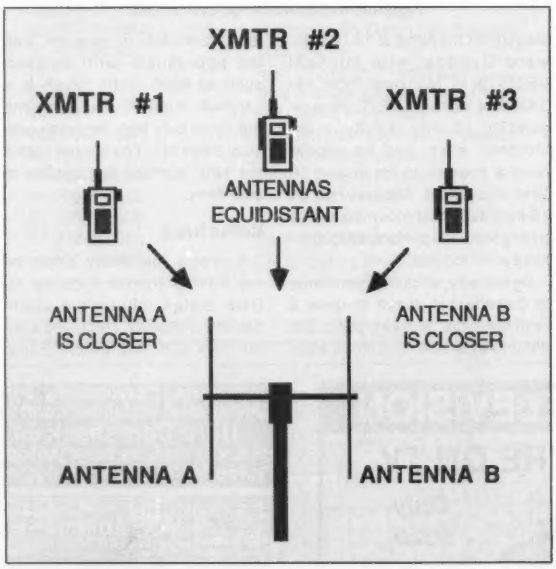


Figure 1. A TDOA RDF system tells direction by determining which of its antennas is closest to the transmitter.

Build the "Handy Tracker"

Photo A shows how simple a DF set like this can be. This unit connects to your handy-talkie or scanner, and you rotate it by hand to take bearings. You could also mount it on a mast and use it for mobile hunting.

If you've used a loop and switchable sense antenna for direction finding on HF or VHF, you'll feel right at home with the Handy Tracker. Operation is basically the same. The difference is that a loop requires measurement of the signal strength, which

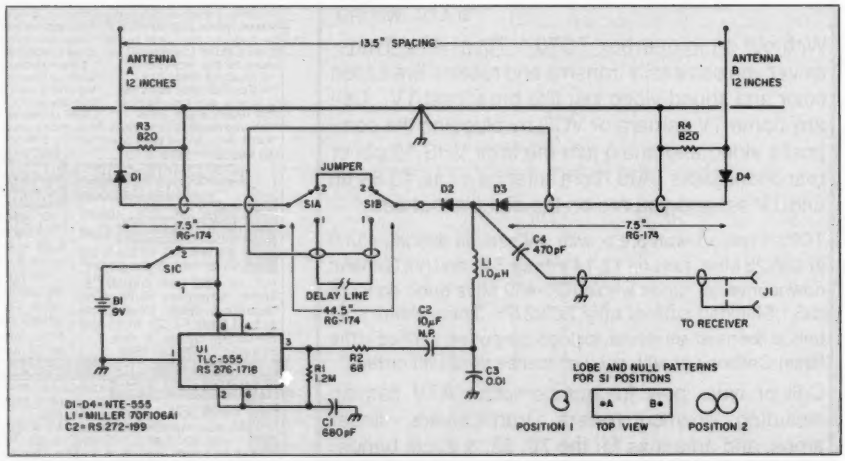
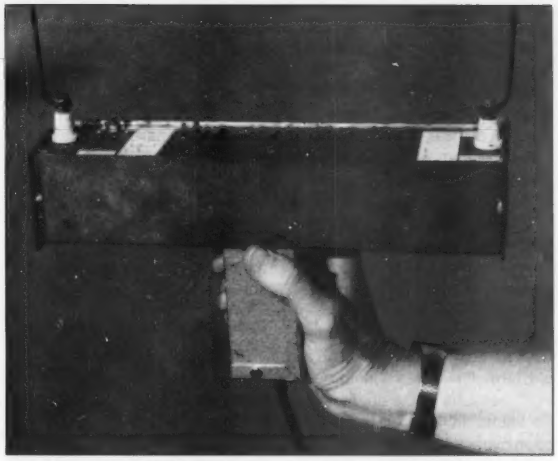


Figure 2. Schematic for the Handy Tracker. Dimensions shown here are for 2 meters. See text for replacement dimensions for 220 MHz.



The Handy Tracker. This unit uses the Time Difference of Arrival technique for accurate long distance work or close-in "sniffing" RDFing.

means you need an S-meter. You'll probably have overload problems with a loop when you get in close. But the Handy Tracker superimposes a DF tone onto the receiver audio, so your ear takes the place of the S-meter. There are no overload problems because it uses phase, not amplitude, to detect the received signal direction.

The Handy Tracker uses only one IC and is very easy to build. An ordinary 9 volt alkaline battery will power it for dozens of hours. Instead of full-length dipoles, it uses a pair of short whips.

Figure 2 shows the circuit. U1, a CMOS timer, produces a square wave that is AC coupled to give both positive and negative polarity drive to the PIN type RF switching diodes. All parts are readily available and should cost no more than $15. The enclosure is double-sided, unperforated PC board material soldered together at the seams to be RF tight.

The antennas must be sturdy and rigid for good performance. I made them from 3/32-inch bronze rod, available at welding supply stores. If you want them to be detachable, use RCA, BNC, or UHF connectors at the bases. Be sure to put some sort of eye protection at the antenna tips (⅜-inch plastic beads work well) and use proper caution when DFing.

Use RG-174 miniature coax for the phasing and delay lines. Coil up the excess length of the delay line inside the enclosure. You can use any convenient length of RG-58 between the unit and the receiver, as in Photo A, or you can mount a BNC connector on the bottom of the unit and use an adapter to connect it directly to your handy-talkie.

S1 is a miniature 3PDT center-off toggle switch, such as C & K #7303. One pole turns power on when the switch is thrown to either side. The other two poles select the RDF mode. In this discussion, we'll refer to the two modes as S1 positions 1 and 2.

A quarter-inch jumper connects the position 2 contacts of S1A and S1B. It's very important that the RF path length between node X (D2-D3 junction) and each antenna base be the same, including the 7½-inch coax lines, the S1 jumper, and the PIN diode leads. One-half inch difference causes about three degrees error in bearings. The leads on the node X ends of L1 and C4 must be short. Solder the shields of the delay line and the D2/D3 ends of the 7½-inch coax lines to ground inside the box at a point midway between the two antennas, as Figure 2 shows.

Tracker Operation

When you have the unit wired up, hook it to your receiver and install a fresh battery. Tune the receiver to the local repeater and set S1 to position 2 (two nulls). You should hear a distinct tone or buzz at about 500 Hertz added to the receiver audio when a signal is being received. If not, check the U1 oscillator circuit.

Do the rest of your performance checks outside, in as clear an area as possible, away from buildings and large objects. Unless you're in a very high location, do your testing with a nearby signal source, such as a friend with a hand-held rig a few hundred feet away. As you rotate the antenna system in position 2, you should find two deep nulls in the tone, 180 degrees apart. If the two nulls are not exactly 180 degrees apart, try shortening the coax line to Antenna A slightly.

Determining Signal Source Direction

On-foot sniffing is easy with your handy-talkie and the Handy Tracker. Use position 2 (two lobes and two nulls) to obtain an accurate line of bearing to the signal source. It's analogous to the figure-8 pattern of a DF loop, with very sharp nulls. Rotate the Handy Tracker for minimum tone in the received signal audio, then sight between the two antennas (perpendicular to the plane of the antennas). The signal is now either ahead of you (like Transmitter #2 in Figure 1) or behind you.

Switch over to position 1 (one lobe and one null) to determine which of the position 2 nulls is correct. Position 1 produces a cardioid (heart-shaped) pattern, much like a loop-sense system. Turn the Handy Tracker ninety degrees so that one end points along the line of bearing and note the tone level. Now rotate it 180 degrees and note the tone level. Unless you're plagued with multipath, there will be a distinct difference in levels. The minimum level occurs when Antenna B is closest to the signal source.

Note that the cardioid pattern of position 1 is not perfect. Depending on frequency and the surroundings, the null may not be so deep as to make the tone disappear, or there may be two closely spaced nulls. This isn't a problem because the only purpose of position 1 is to determine which one of the position 2 nulls points to the source. Once the unit is tweaked to give exactly 180 degrees of difference between the position 2 nulls, these nulls will be quite reliable. Use position 2 to get your accurate line of bearing.

Accidental transmissions from low-power handhelds will probably not damage the PIN diodes. But the short antennas aren't a good match for your radio, so avoid transmitting through the unit. I recommend using one watt resistors at R3 and R4, just in case your finger slips and squeezes the push-to-talk switch.

Dimensions in Figure 2 are for 2 meters. To build a set for the 220 MHz band, use 8-inch antennas spaced 8⅞ inches apart. Make the delay line 29 inches long. 73

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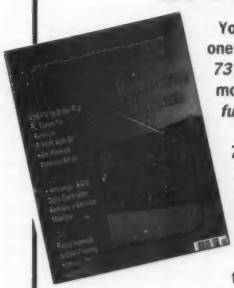

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ASK KABOOM

The Tech Answer Man

Michael Jay Geier KB1UM
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Grounded!

If there's one truly universal concept in electronics, it's the notion of ground. We ground our rigs and towers. Our electrical outlets have grounds. Inside our radios, the circuits are grounded to each other, usually through the metal chassis. Everything seems to need a ground. But just what is a ground, anyway??

Mother Earth

The original notion of electrical ground was THE ground. The one you walk on. In fact, British nomenclature still uses the term "earth" where we use "ground." They say that the radio is "properly earthed."

Natural electricity, such as lightning and static discharge, generally completes its circuit via the air/ground interface, that being the point of greatest physical discontinuity (solid to gas), and therefore the most likely point of strongest electrical potential difference.

The ground is the great sinkhole where electrical charges can be dumped, never to return. In the case of lightning, it can often work the other way around, with bolts leaping from the ground to meet the clouds. But the sinkhole concept is a very useful one, and we'll revisit it soon.

Like everything else in electrical science, the term "ground" has evolved to mean much more than simply "the ground." Today it refers to the common point in any circuit from which other voltage potentials are referenced.

Let's Visit the Relatives

This idea raises an apparent paradox: How can one point (ground) be positive with respect to one voltage and negative with respect to another AT THE SAME TIME? Surely positive is positive and negative is negative, and never the twain shall meet, right?

Nope. Like almost everything else in the known physical universe, it's all relative. Imagine, for a moment, that you're in your car, doing 65 mph (relative to the ground) on the interstate. You're approaching a car doing 60 in the next lane. Coming in the opposite direction is a car doing 55. Relative to you, the opposite car is going 120 mph, and the car upon which you're gaining is only going 5 mph. But to each other, they're going 115. And if you arbitrarily pick north (your direction) as "positive," then the opposite car coming at you is negative, and so is the one you're approaching (because they're both coming at you)! From the point of view of the ground, both you and the car next to you are positive, and only the opposite car is negative.

So, negative and positive are strictly relative terms, and do not imply any absolute quantities! The same holds true of electronic circuits. Oh, sure, you've heard that negative means an excess of electrons, and positive a deficiency of them. Yes, but only in relation to each other. If point B has more electrons than point A, then point B is negative with respect to point A, even though it may be positive with respect to point C, which has still more electrons. In this case, C is negative with respect to both points A and B.

With your black ("negative") VOM lead connected to circuit ground, let's say you measure +12 volts at one point, and +8 volts at another. If you then put the black lead on the +8 volt point and check the +12 volt point, it'll read +4 volts. If you leave the black lead on the +8-volt point and try to measure ground, it'll read −8 volts.

Back to the Sinkhole

So, ground is really just the point which has been chosen to reference all other points in a circuit. But it also is assumed to possess one other quality, and this is the one which may be most relevant to us as radio amateurs.

Ground is chosen to have the lowest possible impedance with respect to the outputs of the power supply. In other words, signals come in, but they don't come out! They are routed right back to the power supply outputs (whence all signals come, after being modulated by the various active stages), and are therefore effectively shorted out, having completed their circuits. That is the function of the 0.1, 0.01 and 0.001 mF caps you see around most power supply connections to RF circuits.

That's why signals bypassed to ground don't show up in other stages. When that very low impedance is missing, circuits start oscillating, due to their own, or other, unwanted signals feeding back through power inputs. The old term for it was "motorboating," because of the characteristic sound in audio circuits. An open bypass capacitor was invariably the culprit.

DC, AC and RF Grounds

A capacitor can provide a good AC or RF ground connection because AC signals will effectively pass through it. DC will, of course, be blocked by the cap, so the impedance at DC will be infinity, like an open connection. Similarly, an inductor (coil or choke) can be used to ground DC, while blocking AC. These techniques are very commonly used in circuit designs, and provide powerful tools for manipulating signals.

> ***"The original notion of electrical ground was THE ground."***

The type of ground that gives us hams the most grief is the RF ground. Why is it different from other types? It's basically an AC ground, but it has the distinction of requiring a low impedance at rather high frequencies, and that is easier said than done.

The higher in frequency you go, the more a given amount of inductance will impede a signal. Thus, the higher you go, the shorter a length of wire or other conductor needs to be for its inductance to become significant. That's why coils for 2 meters are far smaller than those for 75 meters!

Imagine a graph of a sine wave 75 meters (about 225 feet) long. Any two points only, say, 12 inches apart, will have very little change in the wave, or voltage potential, between them. If, however, the wave is only 20 inches long, then 12 inches represents a great deal of change.

At 3.730 MHz, two points 12 inches apart on a metal chassis will be at the same potential because the wavelength is so long that, as a percentage of it, 12 inches is insignificant. At microwaves, though, those points may be SEVERAL WAVELENGTHS apart, and may have very different voltages on them. Thus, they will not truly be connected to each other, even though they are connected to the same piece of metal! If that chassis is meant to be a common ground, some serious problems will result.

Grounding Your Station

For your station to operate at its best, it should be well-grounded with respect to the earth, at the highest frequency you use. Why? The reasons are varied. For one thing, RF in the air reflects, or "works against" ground, and grounding the radio helps complete the circuit and prevent feedback, as in the motorboating example. This is especially true with unbalanced antennas such as long-wires, which have no counterpoise to complete the circuit, and thus work poorly unless the earth is coupled into the circuit via the station ground.

Also, any natural discharges, such as nearby lightning, will hopefully be coupled to ground through the low-impedance ground path instead of through YOU to ground. By the way, actual lightning is not required—I've seen half-inch sparks between the antenna terminals of a 40 meter dipole, just from unsettled weather's causing a potential difference between the dipole's legs!

The best method for creating an effective station ground is to use wide wire braid, as short as possible, to several long rods driven into the ground near your station. As long as the braid is shorter than ¼-wavelength of your highest operating frequency, this arrangement should do the job. The width of the braid matters because of the "skin effect," whereby high-frequency signals tend to travel near the surface of a conductor. A regular piece of wire just doesn't have enough surface area, making its apparent impedance go way up.

Alternatives

Unfortunately, many of us live in locations which make such a ground impossible. A cold-water pipe can sometimes be a decent ground, but only if it's connected to the earth. Some newer systems use sections of plastic piping and so are actually not grounded! The ground pin of an electrical outlet is

also usable, but remember, it is meant to be grounded at 60 Hz, and may be many wavelengths long at 10 meters. If you live in an apartment several stories up, a piece of wire thrown out the window can simulate RF ground by acting as a counterpoise against the antenna's radiator. This will work best when the wire is tuned to the operating frequency and, of course, won't provide any protection against natural discharges.

In a previous column, I mentioned the coaxial ground. Actually, it's a coaxial ground CONNECTION method, and still requires a ground at the other end, but it can really help when the ground is just too far away. If anybody needs it and can't find the column, let me know and I'll describe it again.

In any alternative situation, safety must come first. It is possible to create a shock hazard in a cold-water pipe if the pipe is long enough that there are nodes in the wave traveling down it toward ground. In this case, it may provide a poor ground anyway. Also, using an outlet's ground pin invites TVI by distributing RF to everything plugged into the system.

It's true that many aspects of ground remain unexplained. Nonetheless, there is also a lot of sense to it, some of which I hope I revealed to you here.

Now, let's look at a letter:

Dear Kaboom,

My MFJ 1270 TNC seems to work well, but the DCD light flickers even when there's no signal, and it interferes with proper operation. If I turn my computer off, it goes away! Is there any way to eliminate that false indication?

Signed,
Blinkin' Out

Dear Blinkin'

Sounds like computer hash getting into the RADIO (not the TNC) is causing some spikes to be input to the TNC, fooling it into thinking there's a packet carrier. Try using shielded cable and/or wrapping it through a toroid, right at the radio where the speaker signal exits to the TNC. That should isolate the rig from all those fast computer pulses. Also, is your RS-232 cable shielded? If not, try a toroid there (at the TNC) too.

Have a question? Send it to "Dear Kaboom" at the above address. 73

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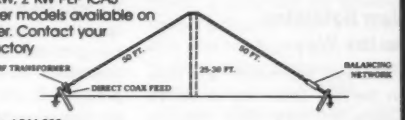

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Andy MacAllister WA5ZIB
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New Satellites on the Way

Microsat information and data on the new University of Surrey spacecraft has been hard to avoid. Articles in the major amateur publications have covered these new satellite hopefuls quite well. Check the May issue of *73* if you somehow missed the media blitz.

Launch is scheduled for November from French Guiana on an Ariane rocket. Four Microsats and two UoSATs will be on board with the French SPOT 2 satellite. It's easy to forget satellite programs in different parts of the world with so much attention focused on projects such as packet hamsats from AMSAT North America and AMSAT Argentina, the 2 meter voice synthesizer from AMSAT Brazil, the CCD camera experiment from Weber State College, and the advanced educational UoSATs. Other hamsats are under consideration, construction, or are scheduled to be in orbit soon.

Russian Hamsats

RS-12/13 was scheduled for launch this year, mounted on a Soviet COSMOS navigational satellite. Like the RS-10/11 pair sent to orbit a few years ago, the new transponder system was designed to have transponders for Mode A (2 meters up and 10 meters down), Mode K (15 meters up and 10 meters down), and Mode T (15 meters up and 2 meters down). It's possible there will be combined operation with Modes KA and KT, using mixed uplinks or duplicate downlinks. Check the table for preliminary details on transponder operating frequencies.

RS-12/13's orbital parameters are typical LEO (low earth orbit) with a height of 621 miles and a period (time for one orbit) of 105 minutes. Maximum transponder output is typically 8 watts spread over the downlink, while the beacons and ROBOTs can be commanded for 0.45 to 1.2 watts out. It is easy to hear the downlink signals on 2 or 10 meters at these power levels.

The auto-transponder, or ROBOT, calls CQ on either its normal frequency as shown in the table, or on the usual beacon frequency, if so commanded by a ground control station. If you hear it, listen carefully to the message. The ROBOT will give the uplink frequency it will monitor during the next quiet period. If RS-13 is active in Mode KA, an uplink frequency on 2 meters will alternate with one on 15 meters after each ROBOT calling period.

To call the ROBOT, first center your uplink carrier until it is a continuous tone on the ROBOT's downlink. Due to Doppler, the announced uplink frequency may be a few kHz off from the best uplink point. Call the ROBOT at a CW speed close to that heard. Usually 15 to 20 words per minute is best. An example sequence would be *RS13 DE WA5ZIB AR* (where *AR* is a continuous di-da-di-da-di with no spaces). Computer or keyer-generated CW is preferred since the ROBOT is also a computer and not forgiving of a poor fist.

The ROBOT will respond with a message and a contact serial number if all goes well. Copy the number and other data if a QSL from "cosmic space" is desired. Send cards to Box 88, Moscow USSR. When the ROBOT has trouble with a signal, an international "Q" signal is sent to signify speed difficulty or just interference (QRM).

frame will provide 11.5 watts of power after launch. F-O-12 started with only 6.5 watts from its silicon arrays. Although the GaAs cells provide more power, they are heavier, and break more easily.

Mission objectives call for continuous operation of the digital packet-radio Mode JD (2 meters up and 70 cm down).

The JA analog (SSB and CW) transponder operation draws an average of 5.3 watts. During periods of continuous sunlight, it may be possible early in the satellite's life to run JD and JA simultaneously. Power drain will be about 10.2 watts, just a bit below maximum solar array output.

"Call the ROBOT at a CW speed close to that heard. Usually 15 to 20 words per minute is best."

Japanese Hamsat

Following the trail blazed by Fuji-OSCAR-12, JAS-1b is scheduled for launch in February 1990. The new Japanese satellite will be sent up as a secondary payload with Maritime Observation Satellite MOS-1b into a sun-synchronous orbit less than a hundred miles lower than RS-12/13.

JAS-1b will pass over a given location on the earth at about the same time every day, but it will experience serious solar eclipsing. Power budget problems experienced by F-O-12 will not be as severe for the new hamsat. New high-efficiency gallium arsenide (GaAs) cells over a slightly larger

The JD FM uplinks include 145.85/.87/.89 and /.91 MHz with a single PSK downlink frequency of 435.91 MHz. The JA analog transponder uplink is 100 kHz wide from 145.90 to 146.00 MHz. The corresponding downlink band extends from 435.90 to 435.80 MHz with a CW beacon on 435.795 MHz. The passband is inverting; lower sideband in yields upper sideband out.

Antennas on JAS-1b will use a ring-type turnstile for receiving and a second turnstile like that on F-O-12 for transmitting. The JA and JD transponders will share the downlink antenna. F-O-12 used separate downlink antennas

Photo A. Full-size model of the Phase 4 hamsat. It is being packed up at the end of the Dallas Ham-Com show, to ship back to Weber State College in Ogden, Utah.

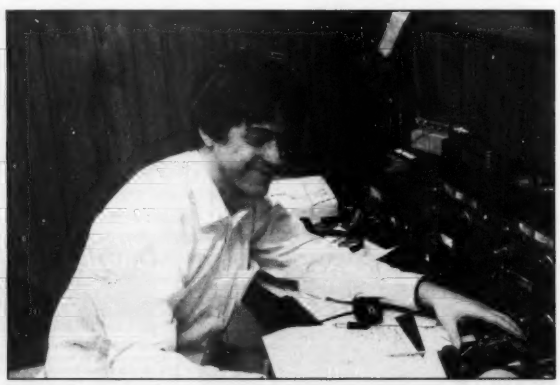

Photo B. Bryan NS1B, 73 Magazine Editor-in Chief, after several CW QSOs through A-O-13 at the W1AW/5 station at the National Convention in Texas. A voice and keyboard mode op, he was pleasantly surprised to discover he could still use a key!

for the digital and analog transponders. The new hamsat requires the addition of a circulator in conjunction with phase splitters to allow for the common transmit antenna.

Even during worst-case solar conditions (33 percent eclipsing), continuous on-board computer operation will be possible. This will allow the satellite's internal housekeeping unit to have more control over the satellite's systems and function management rather than having ground stations constantly monitor system performance.

Dallas Ham-Com Happenings

AMSAT North America presented a full-size model of its geostationary hamsat at the American Radio Relay League National Convention in Arlington, Texas, in June. (See Photo A.) It is an awesome structure to behold at over seven feet in diameter and 30 inches tall—its size alone completely dwarfs previous hamsats. Just the simple model weighed so much that it required several volunteers to unload it from the special van necessary for its transport.

The model was built at Weber State College in Ogden, Utah by students, faculty, and volunteer engineers. AMSAT NA engineer Dick Jansson WD4FAB has documented proposed design specifications and all necessary mechanical drawings with Computer Aided Design (CAD) software.

Transponder frequencies are still under discussion. Modes involving 23 and 9 cm uplinks coupled to 70 and 13 cm downlinks are favored. These are appropriate choices for a geosynchronous hamsat. Small dish antennas could be permanently aimed at the satellite for reliable noise-free communications over a whole hemisphere.

At the convention, AMSAT Vice President Jan King W3GEY and AMSAT President Doug Loughmiller KO5I presented talks describing the Phase 4 concept and its capabilities. Input from Bob Twiggs, the director of the Center for Aerospace Technology at Weber State, emphasized the educational potential of the program. Phase 4 is a viable project and a logical progression for amateur radio if sufficient funding is available. The first flight-ready satellite of this ambitious endeavor could be ready for launch in 1994.

Other satellite-oriented activities at the convention included a complete OSCAR station for W1AW/5. Many would-be satellite enthusiasts got a chance to witness and make hamsat contacts, thanks to the complete station provided by ICOM America. Participants tracked and worked every operational amateur satellite from the special station set up just outside the convention center.

Advanced AMSAT NA tracking software automatically aimed the antenna system while enthusiasts like Bryan Hastings NS1B, *73's* Editor-in-Chief, ran some CW through the AMSAT-OSCAR-13 Mode B (70 cm up and 2 meters down) transponder. F-O-12 and RS-10 also provided excellent QSOs.

Preliminary Frequency Plan for RS-12/13

(All frequencies are in MHz)

	Transponders		RS-12/13
Mode A	Uplink	145.910–145.950	145.960–146.000
	Downlink	29.410–29.450	29.460–29.500
	Beacon	29.408	29.458
Mode K	Uplink	21.210–21.250	21.260–21.300
	Downlink	29.410–29.450	29.460–29.500
	Beacon	29.408	29.458
Mode T	Uplink	21.210–21.250	21.260–21.300
	Downlink	145.910–145.950	145.960–146.000
	Beacon	145.912	145.862
Mode KA	Uplink	21.210–21.250	21.260–21.300
		145.910–145.960	145.960–146.000
	Downlink	29.410–29.450	29.460–29.500
	Beacon	29.408	29.458
Mode KT	Uplink	21.210–21.250	21.260–21.300
	Downlink	29.410–29.450	29.460–29.500
		145.910–145.950	145.960–146.000
	Beacon	29.408	29.458
		145.912	145.862

Auto-Answer Robot RS-12/13

Modes	A, K, T, KA,K,T	A, K, T, KA, K,T
Uplinks	21.129	21.138
	145.831	145.840
Downlinks	29.454	29.504
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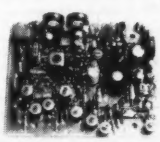

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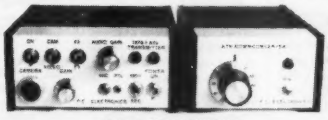

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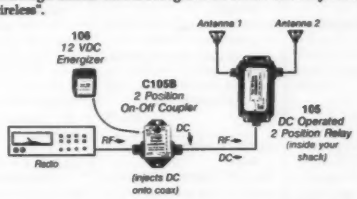

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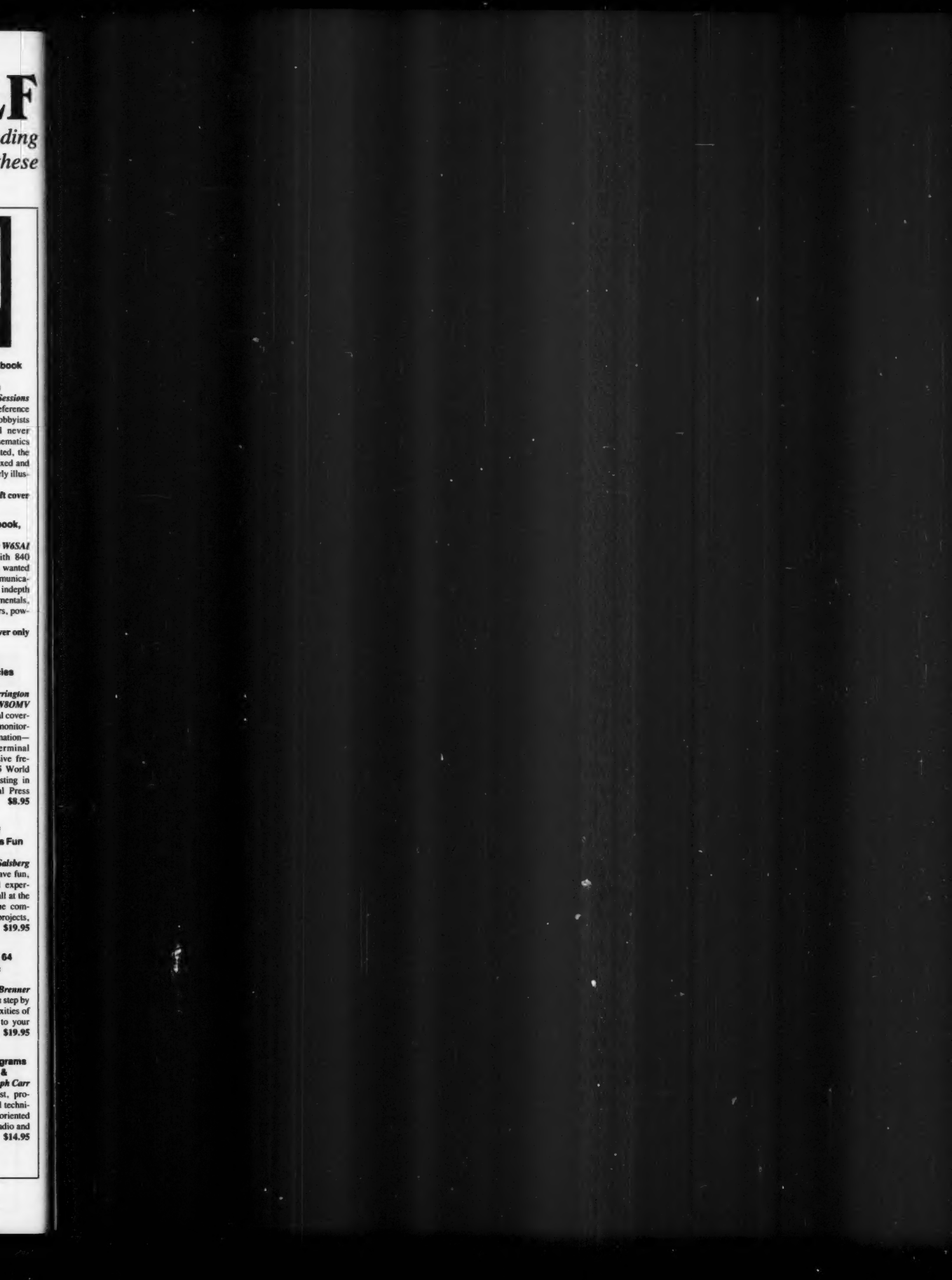

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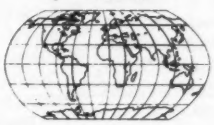

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TECH TIPS

Pearls of Tech Wisdom

IC-2AT Mod

(Reprinted from January '89 *NCARC Communicator*.) I routinely use a half-wave antenna on my IC-2AT handheld. There is a certain amount of movement of the center pin of the BNC connector with the half-wave antenna on the handheld. This movement causes fatigue fracturing of the wire connecting the printed circuit board to the BNC connector.

After numerous failures, I used the braid of RG-174 coax to make the connection, and describe its application here. First remove the BNC from the radio and break off the non-used ground lug. Then place the pin of the BNC into the end of the braid. Then wrap a thin piece of wire around the braid 3–4 times, and secure and solder it. Reinstall the BNC and dress the braid to the solder pad on the printed circuit board and solder. Do not heat the braid too long while soldering, as solder will be drawn up, making it stiff and subject to fatigue fracturing.

KA8CNI

Frequency Pick-off for Your Dummy Load

Years ago, the word "gimmick" referred to a wire inserted close to the VFO or HF rig to cause a change in frequency due to capacitive coupling for FSK with RTTY operation. I decided to add a gimmick to my dummy load to sample RF (see Photo A).

I use a dummy load to test and align equipment, and I also wanted to use it to check the signal on a frequency counter, deviation meter, and oscilloscope. Adding the gimmick required drilling a single hole in the end plate of the dummy load and installing a BNC connector with a length of 1/16" brazing rod soldered to the center conductor (any stiff wire will do).

The RF level picked up by the gimmick varies with both frequency and power. The highest level of RF sampled is at the highest frequency at the highest power. Exercise caution. You may want to use an attenuator or other method to ensure that the RF level does not exceed the limits of your test equipment.

W.C. Cloninger, Jr. K3OF
Rockville MD 20853

ICOM IC-37A Tips

(Reprinted from December '87 *220 Notes*.) The Condor Connection is an incredible 220 MHz repeater system linked from San Francisco to Las Vegas to San Diego. The 27A, 37A, and 47A rigs are so similar that the following tips should apply to all.

1. To improve high frequency receive audio response, replace C103 on the main unit with a 0.0022 µF (2200 pF) Mylar™ capacitor.

2. To improve low frequency receive audio response, replace C106 with a 0.22 µF Mylar capacitor.

3. To eliminate distortion in the transmit audio, install a 4.7k resistor inside the microphone case in series with the white wire coming from the microphone element.

The · ·t the DTMF level pot to the middle of its range (the only pot inside the mike case). Then adjust R88 inside the rig for the desired "mike" ' ·vel.

4. To improve the receive sensitivity, power output, SWR at the radio, and reliability, remove the RG-58 pigtail and the UHF connector extending from the rear of the radio. Install a BNC chassis mount screw-in connector (UG-1094/U) in the hole left in the back of the radio. The new connector will screw in as if the modification were done at the factory.

5. To greatly reduce chassis heating in the receive mode, remove the following components: R66, R67, R68, Q32, D42, and D44 in the main unit. Install a 7808 (3-pin, 8 volt regulator) on the transmitter power amp shield behind the space reserved for the optional speech synthesizer. Thermal compound is recommended. Hook the input of the 7808 to the point where R67 and R68 are connected. Hook the output of the 7808 in series with a 1N4001 diode to J14-1. The cathode of the 1N4001 goes to the connector, and the anode goes to the 7808.

Original modification by Mark Gilmore WB6RHQ.

The Independent Repeater Association, Inc.
Byron Center MI 49315

Take Your Mike to the Dentist

If you have a new TM-701A, TM-231A, -331A, or -431A, and your FM modulation is low, you might want to pay a visit to your family dentist.

The weak FM modulation from these new Kenwood rigs lies in the supplied microphone (the MC-44DM). Its housing has a very small hole for capturing audio. I tried to adjust the FM deviation in my TM-701A, but I didn't make much progress. Then I decided to enlarge the hole on the microphone itself.

I took the MC-44DM mike to my office. With a high-speed drill (for drilling teeth) and a large round burr (#8), I enlarged the hole. To make the margin look nicer, I used a finishing carbide bur (#556 or 557). The result was a good 70% improvement in FM modulation.

The next time you go to your dentist, take your Kenwood mike along, too.

Paul D.A. Hoang, DMD NA1A
Malden MA 02148

Hands-Free Stirrer

Making your own PCBs used to be expensive and messy, but products like TEC 200™ Film have made it easier. Yet one time-consuming step remains—etching the board. We still have a 15–20 minute wait while we patiently agitate the board or stir the solution.

I thought there must be a solution to this problem, and I found one. My hands-free stirrer consists of a small electrical motor driving a propeller that stirs the solution (see Photo B).

I bought the motor, the crown gear and bushes, and the propeller at my local hobby shop. The motor and propeller were intended for a toy boat, and the crown gear and bushes came from the back axle of a slot car racer. The propeller shaft is a piece of welding rod, and the wood is from a tomato box. The size of plank you use will depend on the size of the dish you use for etching. The propeller shaft must be long enough

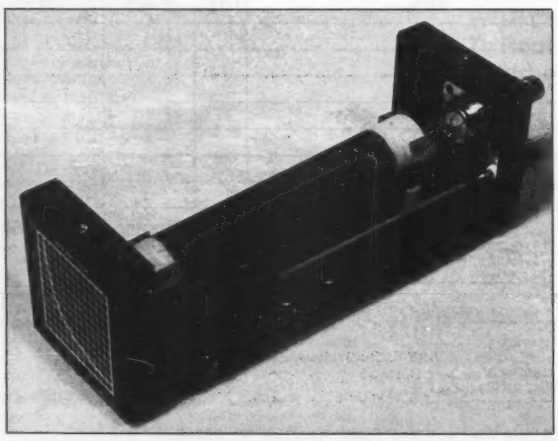

Photo A. Dummy load frequency pick-off.

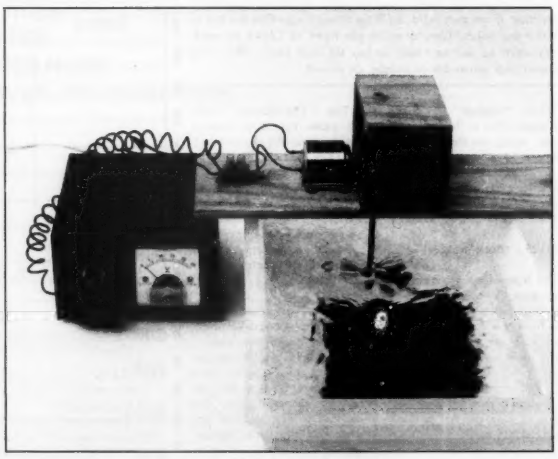

Photo B. The hands-free stirrer.

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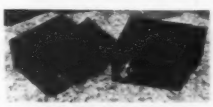

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for the propeller to be under the fluid, but clear of the bottom of the dish. I have not given dimensions because it depends on what you have in your junk box, or what you can salvage from the kid's junk box.

The motor I used was designed for 1.5 to 3 volt operation. Dropping the voltage slows the motor, which is necessary, as you don't want the liquid to splash out of the dish.

If you use welding rod, or any metal, for the propeller shaft, remember to treat it with several coats of lacquer or varnish to protect it from the etching solution. If the propeller has a brass insert, it must be treated as well.

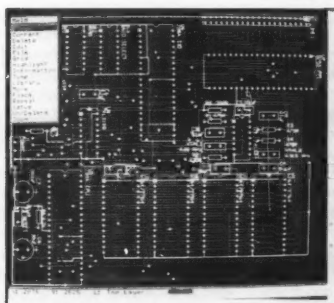
A word of caution. If you go to the hobby shop, you'll find a magical world of toys for boys and girls of all ages. Be prepared to come home with far more than you had planned!

James Bestbier ZS1XN
South Africa

Yaesu FT-902 Mods

Adaptation from LABAK @ LA5IV via KB8CI: I have now tested about 18 modifications on the Yaesu FT-902 transceiver. I am rather surprised to see some of the circuit designs. I tested the RF-clipper (so-called Processor) with different ways of modulating it. Action was very much dependent, and reports on the air said that nobody could hear any RF-clipping. I believe that whatever level of quality, it should be possible to hear the sound of clipping. So my tests on the bench showed that the "differential clipper IC" did not really work, but with a simple modification it could be forced into efficient work. Only 2 diodes (1N4148 in anti-parallel) across the IC output did it. The output level control: I did not find any practical operation of this, either, although I found the position on the front of the transceiver. Perhaps it is mounted to use some free space? I replaced this with a 2N5462, and the 47k resistor with 10k, and yet the output could be shifted at least 6 dB (ALC operation limits the range).

January '89
NCARC Communicator



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CIRCLE 378 ON READER SERVICE CARD

Never Say Die

Continued from page 6

Dwight Bulkley in his book, *The Mechanisms of Life*, postulated that part of the DNA replication function might include imprinting magnetic fields from adjacent benzene ring molecular segments. It wouldn't take much to upset this, particularly when we get down toward the low frequencies at which the body seems to be working.

Not much work has been done yet on VHF frequencies, so we really don't know what cellular effects they may have. It's sobering to reflect that a six-foot person makes a dandy full wave tuned receptor at two meters. Two meters is about six feet, you know. Then, if we add those deadly low frequency PL tones to the mix . . . ? Maybe we've been doing our kids a favor by making it so difficult for them to get into ham radio, thus perhaps signing a warrant for their early death.

But heck, though you aren't into pot and crack, a discouragingly high percentage of you are addicts and are shortening your lives. I see you smoking, drinking those 807s and waddling by my booth at hamfests. As a reformed smoker, drinker and eater, I'm as righteous as they come. Yes, I smoked once. I even got expelled from school for it. Drank for a while, too. I finally got fed up with being fat and took off 85 pounds 16 years ago—and kept it off.

So I can understand why, as long as you're knowingly shortening your life with tobacco, alcohol and fat, the added problem of getting your cells scrambled by 60 Hz magnetic fields might not rate a high priority.

Yet, when you consider that over 50% of the women with pregnancies and working with VDTs in some newspaper and airline offices have had miscarriages or children with severe birth defects, we're not talking some vague late-life misery. We're talking a powerful genetic disrupting force which can knock you and your family out in short order.

This book should put an end to any further decisions to implement the Navy ELF systems for submarine communications. It surely will put their 420 MHz long-range radar systems, which are pulsed at 18 Hz (Cape Cod) out of business once the local people get wind of what it's doing to them.

In the meanwhile let's get going on some inexpensive gaussmeters.

What's Doing at *73*?

The lack of youngsters coming to amateur radio has sure put a crimp on my ability to find enthusiastic young hams to work at *73*. In the past I've hired hams interested in learning about publishing and being involved with the hobby. I never had any problem finding youngsters—OMs and YLs—to work with me testing new ham gear, editing the magazine, helping at hamfests, and keeping W2NSD/1 active on all bands and modes. Today, with *73* growing again, finding young staffers has been very difficult. I've been advertising in *73*, the New Hampshire and Boston papers, and even trying employment agencies.

You'd think I'd have a stream of youngsters calling. Heck, how could a ham ask for more fun? I've got a new hamshack with the latest in ham gear, a huge new tower and beams. I need help in getting back on OSCAR again, setting up with the newest in SSTV, packet, adding features to our 2m repeater system—things like that. That's not work, that's fun for a young ham!

Yes, of course, there's *73* work, too; helping find hams who have built gadgets we'll all want to read about, keeping up with the state-of-the-art in ham experimenting (let's see, where's that article on a narrowband quenched gap rig?). And since I can't get to as many hamfests as I'd like, I need someone to shave his head, wear my W2NSD/1 hat, and give booster talks at hamfests. With some dark glasses no one will ever know it isn't me.

Lacking youngsters for *73*, perhaps there are some readers who'd like to help out at home. You can't get me back on OSCAR, but you can let me know how you like any new piece of equipment you buy. I'm sure all the *73* readers would like to know about it. No, we're not interested as much in a laboratory report as we are in a ham shack report.

When I'm thinking of buying something new—which is most of the time, a lot of thinking, not so much buying—I want to know what others who've bought it have found. Is it easy to use? Is it fun? Does it do everything the ads say? What do I need to go with it? I want to know how it was for you and how you think I'll like it.

Wouldn't you rather know how other average hams make out with new gear than read a scientific lab report? On a transceiver, how useful are the memory channels? How easy is it to change bands? What kind of signal reports does it bring? Will it control my amplifier OK? What problems may I run into?

Let's say you've finally made the big move and bought a packet unit. What happened? How has it worked out for you? Are you happy with it or do you wish you'd bought another? How was your first packet QSO? Are you having fun? Would you recommend we all give it a try? Any helpful ideas to make our packet experience more fun?

I'm not going to be satisfied until I'm able to publish reports from users on every new piece of ham gear, from the largest to the smallest. I want to be able to look back in *73* and find out enough about anything I'm interested in to make a buy/no-buy decision.

The Drum Contacted

Well, it took a while, but I finally made a contact with the *USS Drum SS-228*. As it says on the card, the *Drum* was named for a large sea bass found off the North Atlantic and Gulf coasts. Built at Portsmouth, New Hampshire, she made 13 war patrols, and was awarded 12 campaign stars and sank 15 Japanese ships totaling over 80,000 tons.

The *Drum* is tied up at the Battleship Park in Mobile. If you get a chance, stop by and pay it a visit. You'll find the *Drum Newsletters*, which I've been publishing for many years, on display. They tell the fascinating stories of our adventures.

Murray Flanders K4RQQ has been operating from the *Drum* in recent weeks. You might take a listen for him on 14,243 on Saturdays at around 1830Z, but don't jam the Submarine Veterans Net.

I reported aboard the *Drum* as a Radio Technician in 1943 and served on her for her last five war patrols. We saw plenty of action all around the Pacific.

It was fun finally making a ham contact with the *Drum* 45 years after serving on her.

Actually, we sank more than we got credit for. I remember some ships we torpedoed and heard sink and break up—a very distinctive and upsetting sound. The Japanese patrol boats kept us from coming to the surface and seeing the ships sink, so we never got credit for them.

Ham Merit Badges

The Boy Scout merit badge system has a lot to recommend it as a way of encouraging youngsters to achieve skills. So how come we don't have a similar program going in amateur radio? It seems like a good idea to me, even if I did think of it (in the shower, where most of my ideas arrive).

The Boy Scout merit badges aren't easy to win—neither should ham merit badges. For instance, a DXing merit badge might be achieved by hams who have over 300 countries confirmed. That's 300 out of the 400 of the DX Dynasty Award, where all countries are accepted as such by IARU member societies. It takes some dedicated DXing to work 300 countries. Oh, it's not difficult to work 100 countries in a weekend—I've done it. 200 took me a month. 300 a year.

How about an RTTY badge? 100 countries and all 50 states makes sense for this one. Ditto a slow scan badge. We're not talking easy for either achievement.

What would you recommend for a 160m merit badge? I'd say 50 states and 100 countries again. 80m might require the states and 150 or 200 countries. Make 'em really work for it.

Why not a DXpedition badge for operating from 10 countries—with at least 500 contacts per country? Or should it be a thousand? If it's easy, it won't mean anything, nor will it really benefit the hobby. Wouldn't you like to see several DXpeditions on the air every weekend?

A ham author badge might go for having ten articles published, each at least two pages long, in any of the four major ham magazines. No columns, please, I mean articles.

What's a difficult, yet attainable, goal via OSCAR? 50 states and 25 countries? I haven't worked all the states, but I've worked well over 25 countries via an OSCAR.

We definitely need an Elmer badge, perhaps for getting ten new hams licensed, and not just to Novice or Tech.

Most of my suggested badges will take about a year to achieve. Have you any ideas for other badges we might offer?

How about something for contests? Perhaps we might ask that you win as a single operator for your section an ARRL DX contest, a VHF contest and the Sweepstakes—the Big Three. Yes, I've won all of 'em, so I know it can be done. I can also guarantee you it isn't easy.

What can we set up to encourage activity on 10 GHz? How about making contact with at least six grid sectors? I've worked seven states on the band, so you should be able to work six sectors. I'm not asking anyone to do anything I haven't. I did it with 1/10 watt, too, with all contacts over 50 miles and one over 100 miles.

The idea is to come up with amateur radio badges which will help amateur radio to be more fun—to grow—to provide better service. Like perhaps one for QRP with confirmed contacts with 150 countries with less than one watt input—and none of this calling with a kilowatt and asking them to listen for your QRP signal. All contacts would have to be initiated with QRP. Should we make that more countries?

I'd suggest one for mobile, but I remember the chap in California who used to back his car up with a big beam on a tower overlooking the Pacific Ocean. He whacked off countries by the dozen. We don't want easy stuff. Any ideas?

We should have one for six meters—to help get us more activity there. With the sunspots rising rapidly and the possibility of the highest sunspot number in a hundred years or more, working DX will be pretty easy on 6m. I'd suggest working 50 states, but darned few have done that, so it might be asking too much. Would you settle for 40 states and 40 countries?

Judging from the zero number of hands going up during my talk at the ARRL convention in Boxborough when

"Isn't it time we set some goals for all of us to seek—some tough goals?

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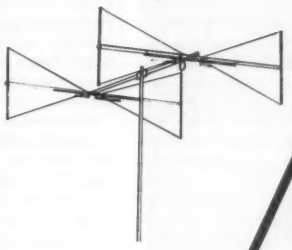

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I asked about some of the above accomplishments, most of the merit complishments, most of the merit badges I've suggested will be difficult. And they should be. If they're easy the badges won't have much value.

Isn't it time we set some goals for all of us to seek—some tough goals? My DX Dynasty Award is tough, but it's too vertical. I'd like to encourage every ham to be well-rounded in interests, not to spend every spare moment for life chasing DX or talking with the same small group on a 75m net. Yes, I've done that too, and it's an experience I'll never forget. I made some great friends—Bill and Olga W1IF in Peabody MA, Homer W1KPL in Jaffrey NH, Leo W1MLJ in Barre VT. But then I've enormously enjoyed other things in my life and then moved on—like flying, boating, horseback riding, rallying and sports cars. Some interests have stuck—like ham radio, skiing and scuba diving.

If we don't start getting some action on 2.3 GHz and the other satellite bands, we're going to lose 'em. What goals can we set for 2.3 and 3.3 GHz?

Perhaps an Elmer merit badge will build more interest in the preservation of our wonderful hobby—a quality which is at a particularly low ebb at present. It sure seems like we have a bunch of hams who would rather see amateur radio closed down than consider some type of no-code license. We don't stand a prayer of getting the kids into amateur radio while we have our Victorian-era restrictions.

If you like the whole idea of ham merit badges we'll get started with it. We'll have to have a contest for merit badge designs, plus make up some nice certificates for the shack wall. And, yes, you bet we'll run an honor roll in *73* showing who's achieved what badges. Now, should we accept achievements from the past or should we start everyone even on January 1, 1990? Since I already qualify for many of the proposed badges, naturally I'm all for accepting past work. It's up to you. If you don't write, you're going to have to shape up to the rules set by those who do write.

Let's see—what performance by a Novice on 10m might warrant a merit badge? 200 countries? Getting a QRP badge should be easy there as the sunspots heat up.

The Webster Bomb

Up until Noah Webster came along and forced standardized spelling down our throats—spawning spelling-bee abominations and endless put-downs for engineers—English words were spelled pretty much as they sounded.

Yes, "know" used to be pronounced more like canoe—we've just gotten lazy and kanocked off the kay when we speak. Now, if we're allowed to change pronunciation to suit ourselves, why not bring our spelling in line? No, this isn't a new idea, it's just one which should be considered, now that the end of the century is within reach.

There was an article in *Analog* on simplified spelling along about 40 or 50 years ago—"Mahem In Ce Klasroom," as I recall. I also recall that John Campbell, the editor, mentioned that the article had been submitted anonymously and never claimed. John W2ZGU smoked heavily and is thus no longer with us.

The problem is—how can an individual break this log-jam Webster has brought on us? How can one person get the English-speaking world to start fixing its spelling system? I suspect the government is too busy dealing with world miseries, Russian adventurism (modern colonialism) on every continent, a fractious Congress, mountains of lobbyists pushing cigarettes, guns, price supports, unions, etc., to worry about something as inconsequential, and potentially explosive, as modernising spelling. The Pribilof Island baby seals carry more weight . . . or "white," as it's pronounced in Australia.

So if the government is too busy, and education is planning to celebrate the beginning of the 20th century soon, how can we get some movement? One way is to be sneaky about it. You no, we mite just be able to get this started via amateur radio. Mite makes rite is an easier spell for CW, RTTY and packet, so what are we waiting for? Give it some thought.

We certainly can follow the recent English change of -ize to -ise on modernise. It won't rid us of zees entirely, but it cood sure save wear and tear on the zee key. We'll still need it for pizzazz, dizzy and lizzy. But, hey, we could cut those zees in half and not lose anything. Pizaz? No, you cant substitute pissass.

It looks to me as if we could save on several dollars worth of apostrophies. Theyre a hangover we dont need too. And no, I have no objection to spelling the same sound different ways—as long as we dont hold onto silent letters. To, too and two Ill buy—tho Im not sure about two—what's that lousy w doing in there? Ill bet no ones pronounced the w for a cuple hundred years or more. Twos bad enuff, but how about eight? Lordy! How on earth did they ever pronounce that bunch of now silent letters? I can see why they've stopped.

Videos

One extremely frustrating aspect of publishing is to see firms by the hundreds just plain throwing away money and then wondering why business isn't better. I got fed up with the almost universal appalling ineptitude in taking advantage of the free advertising that publications offer, so I put together a video to explain precisely how to get at least $1 million more in sales per year just by effectively using PR.

The $99 video has been out for just a short while, yet the testimonials are already coming in—asking if I have any other videos available. Well, I've got a couple in mind.

The basic premise of the million dollar video is simple. A new product release published in a magazine is normally as effective in generating sales as a full page ad. A product test report can be as effective as four pages of ads. Since a magazine with 100,000 paid readers will have ad rates of about $5,000 a page, and the rule of thumb is that mail order advertising should pull a minimum of ten times the cost of the ad, a new product release should result in about $50,000 in sales and a new product test report should pull about $200,000 in sales. At that rate it doesn't take a very concerted effort to build that extra million in sales I promised.

As a publisher of 25 magazines over the last 35 years, I can tell you that I have yet to run into a PR person or even PR firm that really knows how to get releases and test reports published. So I revealed this heretofore secret scoop in my video.

The next video will be on how to double your business by more effectively using reader's service responses. Surveys down through the years have always shown that the firms taking full advantage of a magazine's reader's service cards can at least double their mail order sales.

Here's where I need your help. The fact is that pathetically few advertisers make good use of this powerful marketing medium. Most just plain throw away good money with poor reader's reply materials—frustrating magazine readers who are anxious to buy.

Rather than sending a bunch of reader's service labels addressed to me, which might be a give-away, how about you doing it and letting me know what happens? Check off up to ten reader's service information responses which interest you. Make a note of the date you send us the card and the firms from which you've requested information. As you get the material from them, record the date and then look it over carefully so you can let me know how effective you think it is.

You might rate each package on a one-to-ten basis on how much it made you want to buy the product. If you actually do order something, that's obviously a big plus. Then keep a close record of when you placed your order, whether by mail or telephone, how soon it arrives and how satisfactory the product is.

I'll take the information you send and use it in my video as examples of the best, the worst and the average in reader's service sales literature and response.

There are some benefits. First, the better the *73* advertisers get at sending sales literature, the more they'll sell. The more they sell via *73*, the more they'll advertise. The more they advertise, the more pages I'll have for articles and the thicker magazine you'll have to read. Also, the more advertisers there are in *73*, the more will be attracted, making the magazine even fatter for you.

What should you look for from the advertiser? Well, you certainly want to know about the product in some detail. And you want to know what the benefits are to you of buying the product. What can you do with it? How easy is it to use? You want to know the price. You'd be amazed at how many companies neglect to mention the price, apparently under the odd impression that you really don't care how much it costs.

Do they make it easy for you to buy or do you have to try and find a dealer who has it in stock before you can order?

Does the literature answer all of your questions? Does it communicate the excitement of the product so you want it right now?

Let's get busy and see what we can do to educate advertisers on how to sell their products to us. Buying new ham gear and putting it on the air is fun, so let's get their sales literature doing the work it should.

Yes, I'll keep track of your votes on the literature and publish a list of the firms which get the highest scores.

Data 101

At first I thought it odd how few audio industry people I met had a real grasp of digital sound. With the background of a lifetime of dealing with phonograph records, it's easy to get the feeling that a compact disc is just another way of recording sound—like a record, only read with a laser instead of a needle.

The information on a compact disc isn't anything like that on a record. With digital sound what we do is sample the level of the sound 44,100 times a second and convert the loudness into binary digits. This binary (digital) code is then stored on the disc as little bumps which are then read with a laser and fed into a computer.

The computer in this case converts the digital data back into levels of sound with a digital-to-audio (D/A) converter circuit. We bother to do this because this system overcomes many of the drawbacks we have to cope with when embossing grooves in vinyl records. LPs and their players have all sorts of limitations which get increasingly expensive to surmount as perfection is attempted.

For instance, if the hole in the center of the LP is off even slightly we can hear a slight wavering when we listen to piano music. LPs aren't made to laboratory standards, so there's always some wow due to the center hole being slightly off.

Then, unless we go to heroic measures, there's some player motor rumble. All this is nothing compared to the needle and pick-up problems. The needle either has to be very hard so it won't wear, or else you have to change it all the time. When you pass the needle through the grooves *something* is going to wear—so if it isn't the needle, then it's going to be the record grooves. Fanatics play their LPs just once and record the sound on tape. Other than a laboratory clean room, there's no way to keep dust from being attracted by the record. It's vinyl, so the slightest brushing of it (or playing) knocks off electrons, making it a magnet for room dust. Dust in the grooves can be heard.

Then there are the compensation problems. Loud bass notes have to be

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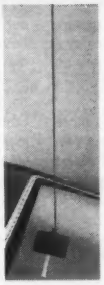

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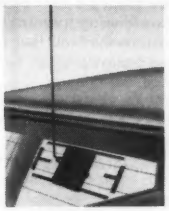

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reduced so the grooves won't overlap. High notes intermingle with the sound of the needle on the vinyl, so they have to be increased to stand out. The whole process is a mess, calling for expensive solutions to each of the drawbacks of the medium.

Tape is as bad—just different. Even the best tape systems have a basic tape random noise hiss level which sets the lower level for sound we can record. Alas, there's no way to separate this hiss from the weaker sounds we're recording. Thus, instead of silence between instrument or orchestral music notes, we hear the tape hiss. There are intricate circuits to cut down this hiss, but it's a basic limitation of any analog tape system. This is something audio fanatics who tape their LPs in order to preserve them just have to live with.

Another serious tape problem is bleed-through. This is the imprinting of louder sound passages from one layer of the tape to the next. You hear it as musical ghosts preceding or following loud sounds.

One other point—duplicating. Whenever we make a tape of an LP we lose just a bit, plus add more tape hiss with each generation. After a few generations of copies the sound is often degraded beyond acceptance. With digital sound each generation is perfect—there is no loss or addition of anything, no matter how many copies of copies are made.

Now, with digital, we get away from all those problems. No wow due to off-center holes or player speed variations, no rumble, no tape hiss or needle noise, no problem with needle inertia, jumping grooves, dust and so on. You can see why compact discs got so popular so fast. With digital sound there is zero sound added by the system—so you're able to record and play back total silence, if you want.

In practice it's impossible to get concert halls or even recording studios absolutely silent. People make noise—breathing, shuffling feet, turning the pages of their music, squeaking their chairs slightly, coughing, whispering and so on. Even with sound-proofed walls there's still some sound from passing trucks, airplanes, an air-conditioning system, electronic equipment with blowers and motors—and you can hear all this stuff during the silent passages between notes. Well, it isn't any more than you'd hear at a concert, so what's the beef, right?

Now, with that background, and remembering that all we're storing on compact discs is digital information, perhaps you can understand why it's just as easy to translate the digital information into anything else we want. This is where they came up with the CD-ROM—where a compact disc is used to store data which a computer can then use.

The computer age has changed the definition of the word "information." Our computer systems can convert information (digitally stored data) into music, into names and addresses, into computer programs, into graphics, even into video. It's all data and this concept has profound implications for amateur radio.

We've already had amateurs sending digitally encoded music over the air, and it's legal. We send data—what it's converted into by a computer afterward is irrelevant. It can be words which make messages, music, pictures, a newsletter page, or even porno movies. All quite legal.

If we're going to send data at a 44.1 kHz rate, we're going to need channels about 200 kHz wide. The bandwidth is determined by the amount of data you want to transport per second. For just plain words the amount of data can be very small. Real-time video is a hog.

No, until recordable compact discs come along, we can't use 'em for much in amateur radio, but we will be able to use digital audio tape (DAT) or even pulse-code multiplexers (PCM) with video tape recorders to store digital data.

I've mentioned that by encoding our English words into 16-bit bytes we can handle a 64,000 word dictionary, with each word being defined as a number between zero and 64,000. At a 117K baud rate we can thus send about 350,000 words per minute through the system. This data rate is possible through our ordinary telephone lines, so we should be able to gear up to accommodate it via amateur radio links.

With the average amateur message running maybe 240 words, we're talking about a 25th of a second to pass the message. If we move it up to one of the music sampling standards of 32 kHz, 44.1 kHz or 48 kHz, this would move the data through much faster—three, four or five times as fast—getting us down to a hundredth of a second for the average ham message. At this rate, if we have a communications network which stores and forwards the data, we don't care as much about bandwidth. We trade off bandwidth for throughput.

If you think all this is blue sky, you haven't been reading the papers. AT&T is gearing up to provide an interconnection between computer/communications systems in the 1990s. These systems will automatically accept any individual communicator and integrate the user into the whole worldwide system. It won't matter if the communication system you're using is in your home, at your office, in your car, on your boat, or even in your hand as you walk. It'll instantly integrate into AT&T's world data communications system when you turn it on.

Now, are we going to be left completely behind in the dust, braying our CQs and fighting pileups on 20m? AT&T is purposely setting up their coming system to encourage third-party firms to develop equipment, software and accessories to compliment the whole system—using the approach IBM did to get their PC accepted quickly. This means that there will be zillions of opportunities for small firms to be set up to provide specialized equipment and services, all supported by the worldwide AT&T wide area network (WAN).

Thus hams who take advantage of the wide-open opportunity to experiment with digital communications systems on our ham bands will have an enormous advantage over late comers to the field.

If you're interested in reading more about this developing technology, let me know—or would you rather I start digging up articles on quenched-gap spark and MOPA rigs, exercises in nostalgia from the Good Old Days of amateur radio? Please advise.

Boy Scouts No-Code News

A recent news release from the Boy Scouts of America says they're now offering a merit badge for shortwave listening. It went on to say that up until now the Scout Radio Merit Badge had been based on ham operating skills.

Unfortunately, the Radio Merit Badge has drawn so little interest in recent years that it's now going to be based on logging shortwave broadcasts instead of getting a ham license.

The end of another era in amateur radio.

Selling Frequencies

Were you one of those who laughed when I wrote about the FCC auctioning off frequencies? It's time to laugh again because the Bush budget estimates $563 million per megahertz, with a start of 6 MHz being made available. That isn't going to balance the budget, but heck, an extra $3.4 billion a year here and there won't hurt.

If the FCC decides to take our 1200 MHz band, they might be able to rent it for $33B, and that would make a major difference in the budget deficit. Perhaps we should offer our virtually unused UHF bands up for grabs and give Congress a whole new lease on spending.

A letter from a ham reader in California said, "Some months ago, a member of our federal legislature was in my apartment and the subject of 220 came up. 'What is this 220 MHz that I've been getting all those letters about?' I turned on my receiver and said here it is. After twenty minutes, the comment was, 'How can anyone justify frequency allocations for that trash?' What could I say?"

The Radio Frequency Market

More and more governments are talking in terms of renting radio frequencies instead of having them issued free by government bureaus. Technology advances have enormously increased the number of communications services and needs. This has put an impossible load on the bureaucrats issuing frequencies.

If the FCC goes ahead with its plans for renting radio channels, how wide a band will we amateurs be able to afford? Let's say 20m is put up for rent. At about $1 million per year per 5 kHz channel, how many kHz can we afford?

Let's say we decided to go for a modest 25 kHz ham band. That would be $5 million a year in rent. If we split that 30,000 ways, that's $170 each for us per year. If we figure 365 days and 16 hours per day times five channels, that's 29,200 channel-hours available per year—about one hour for each of us. $170 per hour. Hmmm. I dunno, but I think I might be able to get more enjoyment for $170 for one hour somewhere else.

Of course, we can always get busy and get more young hams into our hobby and maybe put a stop to this nonsense.

Mr. NiCad

It seems as if Mr. NiCad (Ed Yost) has a booth at just about every major hamfest. Ed's specialty has been keeping our HTs perking. And, considering the frailty of these batteries, he's made a nice business out of it.

Sure, if we took care of our NiCads they'd probably last almost forever. But, alas, we use them in so many pieces of equipment, one almost needs a full-time support person to keep 'em in healthy condition.

I've got 'em in my flash units (4), portable radios (4), several toys (5), cassette recorders (3), calculators (6), portable CD players (3), laptop computers (9), boombox, razor, HTs (10), portable disk unit (3), electric drill, flashlights and so on. There's no way to remember to keep 'em all charged. Or to remember to discharge and then recharge 'em periodically. When I go on trips I have to throw in about five pounds of different chargers because they use a wide variety of voltages and currents.

I've asked a couple of times in my editorials for someone to build a simple, but complete NiCad charger unit which would automatically discharge 'em to erase their pesky memory, have a zapping current to burn out small shorts which tend to develop, recharge them the proper amount and then keep them trickle-charged for use.

The best unit I've seen so far is commercially available and not cheap, but well worth the price just in the batteries it would salvage for me. I've a review article on the unit which we'll be publishing soon.

At any rate, I wasn't surprised when I checked out my HT's spare batteries and found one which wouldn't charge. I opened it up—two cells were dead. Not having that commercial charger to zap the dead cells back to life yet, my thought turned immediately to Mr. NiCad. A call and he had a replacement pack on its way so I wouldn't be in trouble for my upcoming ham conference in Aspen. I UPS'd the wounded pack and had it back in good shape less than a week later—a spare for the trip.

You could do worse than keep a Mr. NiCad price list on hand for when an HT battery zonks out. It's a good place to shop for HT chargers too. Ed seems to have an amazingly complete inventory on hand. 73

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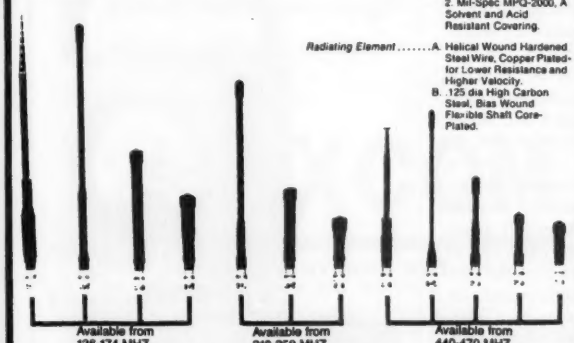

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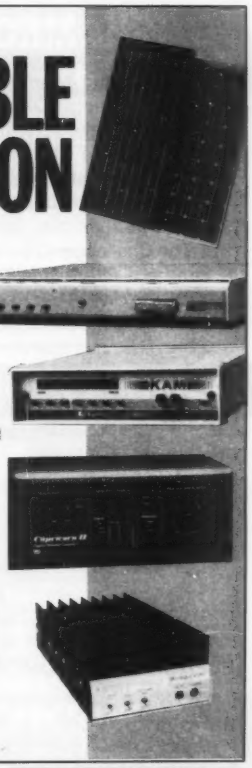

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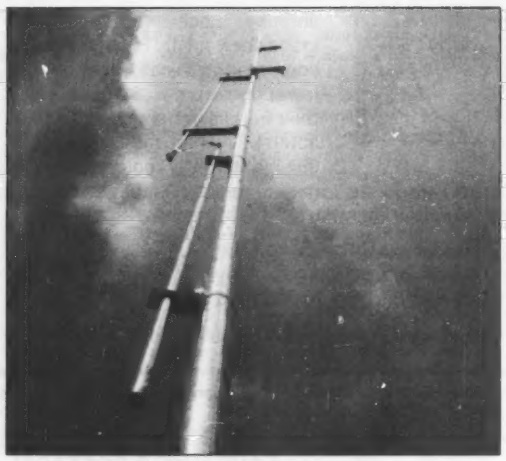

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GAP ANTENNA PRODUCTS, INC. THE CHALLENGER DX-V

G.A.P. introduces its Challenger DX-V, a 5-band, 31.5' high vertical antenna. The Challenger, made of aluminum and stainless steel, weighs 50 pounds, and is self-supporting. You can assemble it in thirty minutes; all sections fully sleeve and have been pre-drilled. A nut driver and drop-in ground mount are supplied.

The Challenger DX-V launches the RF 16' above the ground, and gives less than 2:1 SWR on 10m, 15m, 20m, and 40m. The Challenger has no traps, coils, baluns, resistors, transformers, or base insulators to steal RF power. This pre-tuned antenna performed well without radials on 10m, 15m, and 20m.

The Challenger DX-V sells for $169 from the manufacturer. *G.A.P. Antenna Products, Inc., 6010 Bldg. J, North Old Dixie Hwy., Vero Beach FL 32967. (407) 388–2905.* Or circle Reader Service No. 201.

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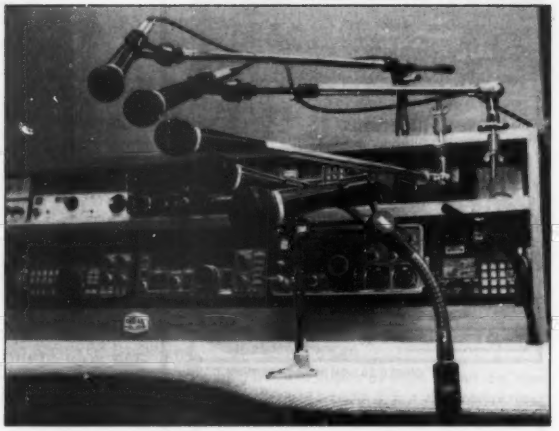
The Eienco XP-620 is a fully regulated 3 output power supply. It provides one fixed voltage 5V DC at 3 amp, and two variable supplies: 1.5V DC to 15V DC and −1.5V DC to −15V DC at 1 amp. The voltage shuts off if a short occurs. The supplies are regulated to better than 0.2V when rising from no load to full load.

The unit measures 8¼"x7"x4". $90 assembled, $60 in kit form. *Elenco Electronics, 150 W. Carpenter Avenue, Wheeling IL 60090.* Or circle Reader Service No. 202.



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BIRD ELECTRONIC CORPORATION

Bird Electronic Corporation now has a portable peak-reading wattmeter, the model 4314B, designed specifically for measuring air navigational aids and other pulsed RF systems, such as telemetry, radar, TV, and command/control. It also measures PEP of SSB and AM signals. Performance specifications are identical to Bird's model 4314, which it replaces.

This new model measures practically any 50Ω coaxial transmission: pulsed, AM, FM, or CW. A CW/PEAK switch allows quick selection. In PEAK mode, you take a peak measurement; in cw mode, the meter works like a standard Bird Model 43 wattmeter.

The meter is powered by two internal 9V alkalines with twice the battery life of the previous Bird model. Or you can use the supplied AC power adapter. Model 4314B is equipped with two Bird QC "Quick Change" female N-type connectors, and is available with other Bird-type QC connectors.

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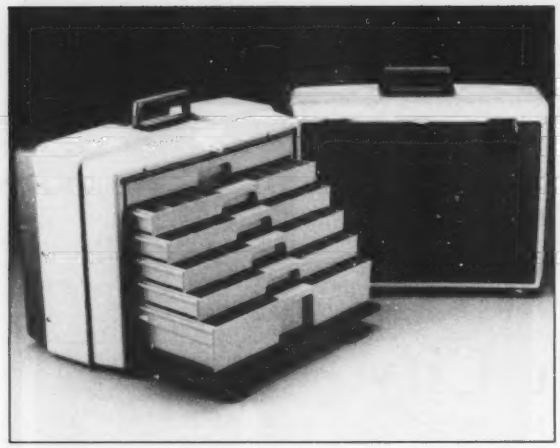

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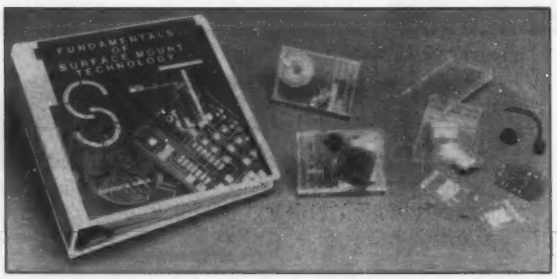

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Heathkit/Zenith Educational Systems now offers a new home study course, "Fundamentals of Surface Mount Technology," developed by Forrest M. Mims, III.

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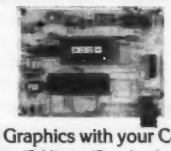

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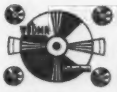

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MRF136Y	47.00	MRF843,/F	22.50	*LOW NOISE FIGURE*	
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Optoisolator Circuit for TTY

For the last two columns, I have responded to many requests by describing several one-chip circuits to enable you to become active on RTTY with a minimum of time and expense. While many of you have computers or video terminals, I am quite sure that many of you would still like to interface these one-chip wonders with a more conventional RTTY loop. To wit, this month's circuit.

Here we use one of my all-time favorite devices, an optoisolator, to convert either a TTL level or RS-232 level to the more common current loop for TTY.

Resistors, Transformers, or Relays?

Before we get too deeply into the circuit, though, a word or two about the optoisolator. You might think you could convert the high level loop current to the low level RS-232 or TTL current with resistors, or a transformer, or some similar device. While you might be able to have some information transfer that way, there is an inherent danger. If the transfer circuit were to fail, high level current might be allowed into the TTL device. At a minimum, this would fry some components. Maximally, it could be quite dangerous.

For this reason, various schemes evolved to isolate the loop from a driving circuit. While a relay might seem obvious, conventional relays are too slow to keep up with the keying pulses of RTTY. One type of relay you can use is the reed relay. This little beauty consists of two thin reeds of magnetically active metal sealed in a glass tube. Either a permanent magnet or electromagnet will cause the reeds to react, making or breaking the circuit. Thus, driving the magnet from the loop allows the reeds to key a low voltage device. This may be ideal for a keying circuit, but the reeds cannot handle the current to key the loop itself.

Basic Anatomy of the Optoisolator

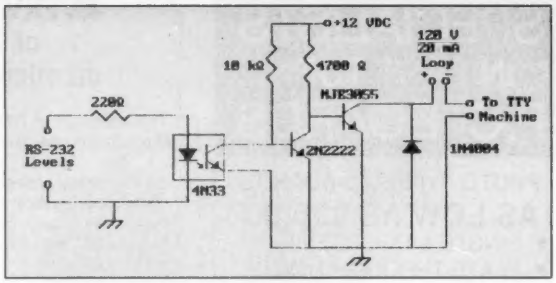
We must use another form of subterfuge, the optoisolator. Most of us are familiar with photocells, those little wonders that change resistance based on the amount of light falling upon their faces. When I was in school, we marveled at how a transistor, with the top cut off the case, makes an excellent photocell. Of course, you can buy transistors prepared this way—phototransistors, naturally.

You are also no doubt aware of the illuminating wonders known as light emitting diodes, or LEDs. Able to produce light from relatively low energy sources, these darlings find their way into almost every electronic device imaginable.

Now, if you take an LED and pot it so that it directly shines onto a phototransistor, you have an optoisolator. The output is directly controlled by the input, but there is no electrical connection; the transfer is accomplished over a beam of light.

Admittedly still a low level, now you can use the output of the optoisolator to key a transistor, and that transistor to key another, power transistor, and that transistor to key a loop. Simple, huh? Well, the figure shows the results.

While I detailed the input as RS-232, a term that should be readily understandable after my last column, TTL levels will also work nicely. You may have to experiment with the value of the 220Ω resistor. The aim is to light up the LED in the optoisolator.



RS-232/TTL to TTY converter.

The rest of the circuit is fairly conventional, and may be built on a perf board with point-to-point wiring, or on a printed circuit board. I have not included printed circuit layouts as yet, by the way, because so few of you have expressed an interest in them. If you would like for me to try to lay out a board, be sure to let me know, for future circuits.

Once again, notice the slightly anomalous power supply, with a 12 volt supply required for the transistors, and a more typical loop supply for the TTY machine. Be careful around those loop supplies, folks. They can deliver quite a kick if you lay your hand across the terminals.

Parts Procurement

Here, as before, a trip to your local Radio Shack should take care of you. Besides the local outlet, [illegible] Jameco Electronics, in Belmont, California, who supports the "Jim-Paks" found on the racks at many electronic and computer centers. You can phone them twenty-four hours a day at 1 (415) 592–8097 to check on the availability of a part or price. Another wide-based dealer I have bought from in the past is JDR Microdevices, of Los Gatos, California, PH: (800) 538–5000.

For your convenience, I listed information on all these suppliers in the parts list for this project. "RS" is Radio Shack, "JE" is Jameco Electronics, and "JDR" is JDR Microdevices. Where no supplier is listed, any of these companies should be able to order the device, but no current price is available as I write this column.

By the way, several of you have expressed difficulties with finding the Exar chips used in the last two months' RTTY Loop projects. Both of the chips are available from JDR Microdevices. The XR-2206 function generator, used for AFSK generation, lists for $3.95, and the XR-2211 decoder, used for the terminal unit, lists for $2.95. They do have a $10 minimum order, so maybe a call to the toll free number will get you a catalog for further goodie shopping. Be sure to mention *73 Magazine* and RTTY Loop when you order, OK?

Every One Different

Next month I will try to tackle the RTTY Loop Survey, the results with which you have inundated me. If there is one underlying thread already apparent, it is that there is no consistency among you. The readers of this column, and one would presume RTTYers in general, are all over the place in interests, equipment, expertise, and orientation. Looks like a fascinating study.

Meanwhile, feel free to drop me a note, with whatever comments you think important enough to convey. Electronically, I keep paying my on-line bills, so you should still find me on CompuServe (ppn 75036,2501) or Delphi (username MARCWA3AJR), via EasyPlex or MAIL, respectively. 73

RS-232 to TTY Converter Parts List

Item	Type	Source	Price
Optoisolator	4N33	RS, JE, JDR	
Resistors	220Ω	RS 271-015	2/$0.19
¼ or ½ watt	4700Ω	RS 271-030	2/$0.19
(Radio Shack parts are nearest whole values.)	10,000Ω	RS 271-034	2/$0.19
Diode	1N4004	RS 276-1103	2/$0.69
		JE	$0.12
Transistors	2N2222	RS 276-2009	$0.59
	2N2222A	JE	$0.29
	MJE3055	RS 276-2020	$1.59
Perf board	0.1" grid	RS 276-1394	$1.99

(Resistor values are nominally within 10%. For all practical purposes, the available Radio Shack values are close enough to the values specified for this project.)

Continued from page 52

Manufacturer's Specifications for the BC100XLT

Band Coverage:	11 Bands
Frequency Range:	29–29.7 MHz, 10m Ham 29.7–50 MHz, VHF Low 50–54 MHz, 6m Ham 118–136 MHz, Aircraft 136–144 MHz, Military Land Mobile 144–148 MHz, 2m Ham 148–174 MHz, VHF High 406–420 MHz, Federal Govt. 420–450 MHz, 70cm Ham 450–470 MHz, UHF 470–512 MHz, UHF T band
Sensitivity:	0.4 µV, at 29–54, 136–174 MHz 0.8 µV, at 118–136 MHz, 12 dB SINAD 0.5 µV, at 406–512 MHz
Selectivity:	−55 dB at ±25 kHz
Audio Output	480 mW Maximum
Channels	100, in ten 10-channel banks
Scan Speed	15 channels/second for scanning mode 25 Frequencies/second for search mode

end overload in normal use, even in such RF rich areas such as Springfield, MA, and on top of Mt. Greylock, a peak in Western Massachusetts, home for over half a dozen repeaters from 6m to 440 MHz and commercial TV.

The supplied rubber duckie antenna gets by for VHF and UHF bands, but really falls short in the 29–54 MHz range. If you plan to do any serious listening in the VHF-LO range, I highly recommend using a different antenna. In fact, overall receiver performance improves noticeably on all bands by substituting a simple telescopic rod. The BC100XLT incorporates a BNC-type antenna connector, making amateur antenna swaps a snap. The same, however, cannot be said of the earphone connector. Uniden uses a 3/32" sub-mini jack instead of the more common ⅛" mini jacks found on most amateur rigs.

IF image rejection is excellent in the VHF-LO range, good in the VHF-HI range, and adequate in the UHF band segment. The squelch control has enough hysteresis to prevent choppy reception under weak signal conditions. Audio output is more than adequate, with crisp, communication quality response. Intelligibility was excellent.

The NiCd battery pack provides approximately five hours of continuous use under normal listening conditions.

While testing battery life, I came across a strange quirk in the BC100XLT, possibly related to the microprocessor. After using the radio until the *low battery* alarm came on, I plugged the wall charger in for an overnight charge. The next day, I unplugged the charger, turned on the radio, and—nothing! When I turned the volume up, it would only motorboat. However, switching on the radio first, and then unplugging the charger/adapter, resulted in normal operation. It's likely that something in the AUTO-OFF feature gets confused when the pack is completely discharged. I repeated this test several times, and obtained identical results.

Bench Test Results

The bench test set-up consisted of an H-P 608D signal generator, H-P 403B voltmeter, and a Tektronix 5110 scope.

Receiver sensitivity for 20 dB quieting measured between 0.35 µV (VHF-LO) and 0.7 µV (UHF), with full quieting occuring between 30 µV and 50 µV, respectively. IF image rejection measured 70 dB in the VHF-LO band, and 45 dB in the VHF-HI band. Because of equipment limitations, I couldn't make this measurement in the UHF band segment, although everyday use suggests this figure is probably lower than the VHF-HI value.

The squelch sensitivity was 0.14 µV at threshold, and 0.3 µV at maximum setting. Squelch hysteresis measured 5 dB, and maximum audio output was 400 mW at the onset of distortion. My tests confirmed the manufacturer's specifications for selectivity, scanning rate, and search speed.

Conclusions

So how does the Uniden BC100XLT measure up? Overall performance was excellent, and uncommon for such a low price. My only complaint with the receiver is its relatively low IF image rejection figure for the UHF band segment.

As far as physical packaging goes, the only detractors were the cramped keyboard and the plastic case. If I could make any changes to this unit, I would opt for an aluminum case with a belt clip on the radio itself, since the belt loop on the carrying case is awkward to use. These are, however, minor problems.

All things considered, I conclude that the Uniden-Bearcat BC100XLT offers very good performance, easy programming, and many worthwhile features wrapped up in an attractive, low-cost package. 73

Thomas Rowinski KA1MDA has been a ham for 5 years, and is an avid auto RDFer. Tom currently works as electronics technician for Titeflex in Springfield, MA. Other interests include photography, sound design in theater, and SWLing. He can be reached at 292½ South St., Northampton, MA 01060.

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#29	13-15 wpm Speed Builder
#30	15-17 wpm Speed Builder
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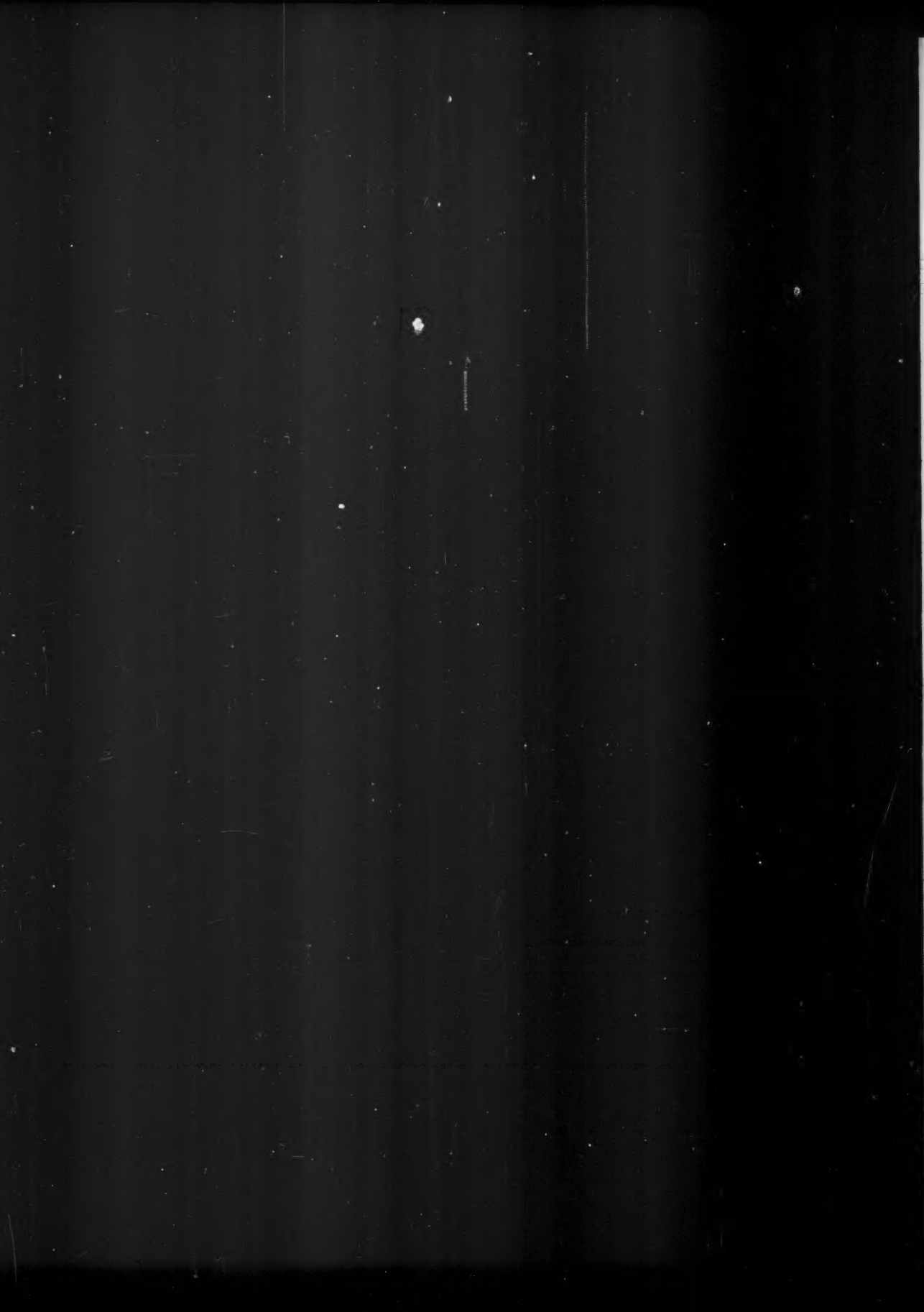

Number 26 on your Feedback card

QRP

Low Power Operation

Mike Bryce WB8VGE
2225 Mayflower NW
Massillon OH 44646

Building a Field-Strength Meter

Getting the most out of your signal: That is the name of the game. Fine tuning the antenna system can become much easier with this handy little tool, a tunable field-strength meter. I've been using this little critter for years. Many a time I've been saved by this meter, especially during Field Day operation.

Parts

This is really a junk box project. In fact, I built the unit pictured from the odds and ends off my bench. As a matter of fact, I could probably build a five-inch color TV from what is on the top of my workbench. If you're not this well-supplied, you can get all the parts for the project at your local Radio Shack store, except for the meter. Raid a good friend's junk box for a usable meter—Radio Shack no longer stocks the model needed here.

Before we get started digging up the parts, let the soldering iron heat up a bit while we look over the schematic. You'll notice the lack of a transistor amplifier or op amp. Using a battery-powered field-strength meter would almost guarantee a dead battery just when you need it the most. The secret of a super-sensitive field-strength meter is the tuned circuit used for receiving the RF energy. No need to worry about a pooped battery when storing the meter in your tool box, or leaving it out in the sun for a weekend!

Simple Circuit Workings

Rectify the RF with a small signal diode, then apply the DC to the meter. L1 and L2, with C1, form a tuned circuit. Select either coil and use the variable capacitor to tune the LC network to resonance. A small telescopic antenna picks up the RF.

That's about it—nothing really difficult about this project! The only critical part is D1. This should be a 1N60 or 1N34A germanium diode. Don't use a silicon diode because the higher breakover voltage will reduce the meter's sensitivity.

The meter can be just about anything you've got in your shack's junk box. I used a 50 µA movement because that's what I had. You can use a 100 µA, but at reduced sensitivity. Depending on what power level you want to sniff out, you could go as high as 500 µA. Don't go over 500 µA—the meter will be insensitive.

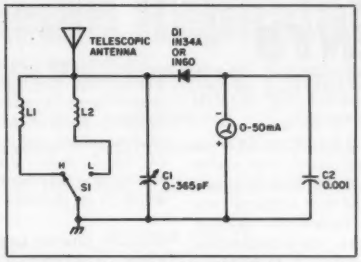

Figure 1. Schematic of tunable field-strength meter.

Construction

Begin with a metal cabinet. Try not to use plastic. You want the RF to enter only from the telescopic antenna. Drill the correct size holes for the tuning capacitor and for S1. After you cut the proper size hole for the meter, mount the meter to the cabinet. In my unit, I did all the wiring using the component leads. You can use tie strips, but keep the leads as short as possible.

Quick Coils

Winding both L1 and L2 is also an easy job. I used a quarter-inch drill shank as my coil form for L2. L2 consists of 18 turns of No. 16 gauge hookup wire. Leave enough lead length for soldering. L1, the low frequency coil, consists of 36 turns of No. 28 gauge wire, close-wound. I used an old Bic Stick™ pen as my form. I cut a one-inch length of the barrel and wound the wire around it. To hold the wire in place, use a drop or two of Super Glue™. This holds the wire in place quite well.

You can, of course, use a large wattage resistor with at least 10k ohms in resistance for L1. Just be sure that you use a carbon resistor and not a wire-wound job. With both cases, L1 and L2, don't worry too much if you can't get the exact amount of turns. This is not exactly a laboratory instrument! We're not going to use it to launch missiles. A little hit or miss will not cause any trouble.

Radio Shack sells a 365 pF miniature variable capacitor. That is what I used in my unit. There's only one problem with this capacitor and those like it: They're a real nuisance to mount a knob on! Here is how I did it: I glued

Continued on page 87

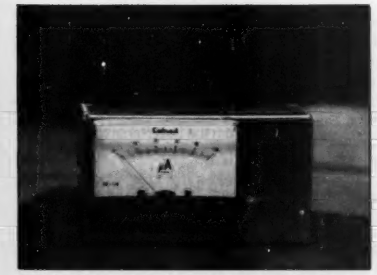

Photo A. The tunable field strength meter. A real junk box project!

Photo B. Inside the meter. Note the lack of parts.

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SPECIAL EVENTS

Ham Doings Around the World

Listings are free of charge as space permits. Please send us your Special Event two months in advance of the issue you want it to appear in. For example, if you want it to appear in the June issue, we should receive it by March 31. Provide a clear, concise summary of the essential details about your Special Event.

UNIONTOWN PA
SEPT 9

Uniontown ARC (W3PIE) will hold its Annual Gabfest at the Club grounds on the Old Pittsburgh Road. Talk-in: 147.045/.645 & 145.17/144.57. Registration $3 each or 2 for $5. *U.A.R.C. Gabfest, % John T. Cermak WB3DOD, P.O. Box 433, Republic PA 15475. (412) 246-2870.*

COTE ST. LUC, QUEBEC
SEPT 9

The Cote St. Luc ARA Hamfest/Flea Market will be held at St. Richards Church. Flea market table, $10. Fee, $2 at door. Talk-in on VE2RED, 147.27/147.87. *Joe Ship VE2JS, 5637 Melling Ave., Cote St. Luc, Que. H4W 2C1. (514) 482–6500.*

BETHLEHEM CT
SEPT 9–10

The Hen House Gang ARC will hold their 65th Annual Argil Fair at the Bethlehem Fair Grounds. Talk-in: 40m, 20m SSB, 40m Novice CW, 10m Novice SSB. Send regular SASE to *HHG, W1FHP, Hard Hill Road, Bethlehem CT 06751.*

MELBOURNE FL
SEPT 9–10

The Platinum Coast ARS presents their 24th Annual Melbourne Hamfest at the Melbourne Auditorium. Registration is $4 in advance (SASE), $5 at the door. Swap tables are $10 one day, $15 both days (limit two adjacent per request). Send request to *Hamfest, 708 Dartmouth Ave., Melbourne FL 32901.*

MOBILE AL
SEPT 9–10

The Mobile ARC, Inc., is holding their Hamfest at the Texas Street Recreation Center. Tables: $6 one day, $10 both days. Please confirm by August 25th. Tables assigned according to date of request. *Larry Early, PO Box 8404, Mobile AL 36689. (205) 342–7601 after 6 PM.*

FINDLAY OH
SEPT 10

The 46th Annual Hamfest is sponsored by the Findlay Radio Club at the Hancock County Fairgrounds. Limited camping, $5 space. Limited power and water. Advance tickets, $3; $4 at the door. Handicap parking. Flea market spaces 10' x 25'. Advance tables are $11 for first, $8 each additional, and $12 at door. Reservation deadline Sept. 1st. Prizes. Talk-in frequencies: 2m and 70cm; 147.75/.15 MHz and 449.15/4.15 MHz. *Forums Chairman, PO Box 587, Findlay OH 45839-0587.* Reservations, *Findlay Hamfest, Box 587, Findlay OH 45839.*

SOUTH DARTMOUTH MA
SEPT 10

The Southeastern Massachusetts ARA is hosting their SEMARA Hamfest. Free admission. Dealer space, $5 in advance or $8 that day. Talk-in on 147.000 + /.6 or 145.490 - /.6 as backup. (No radio test this year.) Send SASE to *SEMARA Hamfest, P-105, S. Dartmouth MA 02748.*

VIRGINIA BEACH, VA
SEPT 16–17

The Tidewater Radio Conventions, Inc., is sponsoring the 1989 ARRL State Convention at the Virginia Beach Pavilion. Advance admision $5, $6 at the door. Features ARRL & DX forums of all types, major commercial exhibitors for amateur radio and computers, VEC Test sessions for all classes, indoor fleamarket , free parking. Talk-in: 146.37/.97. *Manny Steiner K4DOR, 3512 Olympia Lane, Virginia Beach, VA 23452. (804) 340-6105.*

PENNSAUKEN NJ
SEPT 17

The South Jersey Radio Association will sponsor its 41st Annual Hamfest at the Pennsauken High School parking lot. VEC license testing, all classes. K2AA talk-in: SJRA Rptr 145.290/.600. Advance tickets $3.50, $4 at the gate. Tail gate space, $5. Send with SASE to *Ed Ramming AB2Y, 4500 Westfield Avenue, Pennsauken NJ 08110. (609) 663-5539.*

OLD WESTBURY NY
SEPT 17

The Long Island Mobile ARC, Inc., will hold its Hamfest at the New York Institute of Technology. Admission, $3 at door, exhibitors $5. Talk-in: 146.25/.85. Contact *Neil Hartman WE2V, (516) 462–5549 or Mark Nadel NK2T, (516) 796–2366.*

OXNARD, CA
SEPT 23

The Ventura County ARC Swapfest will be at the Oxnard Community Center. Buyers free. Seller's tables, $7.50. All indoor. *VCARC, PO Box 2103, Oxnard CA 93033* or call *Dick WA6JOX, (805) 485-4462.*

BELLEFONTAINE OH
SEPT 23

The Champaign-Logan ARC will be holding their "Hamboree '89" at the Logan County Fairgrounds. Advance tickets $3, $3.50 at the door. Tables, $4. Free parking. Call-in/Directions on 147.60/.00 reptr. *Steven Kidder N8ETD, Box 265, Russells Point, OH 43348.* Or call *(513) 843–6006.*

GRAYSLAKE IL
SEPT 23–24

The Chicago FM Club will sponsor Radio Expo 89 at the Lake County Illinois Fairgrounds. Camping & parking available. Overnite security provided. Indoor flea market tables & electricity. VE exams. Advance, $4; $5 at door. Talk-in on 146.16/.76. *Mike Brost WA9FTS, PO Box 1532, Evanston IL 60204.*

ADRIAN MI
SEPT 24

The Adrian Amateur Radio Club is sponsoring its 17th Annual Hamfest/Computer Show at the Lenawee Fair Grounds. Advance tickets, $3; $4 at the gate. Full table, $6; trunk sales, $3. Talk in: 145.37–444.675. *Adrian Amateur Radio Club, PO Box 26, Adrian MI 49221.*

BERLIN VT
SEPT 24

The Central Vermont ARC is sponsoring the Fall Foliage Hamfest and Fleamarket at the National Guard Armory. VEC exams. Talk-in on 146.625. Admission, $2; tailgating, $4; tables, $6 in advance, $8 at the door. Handicapped accessible. *Todd Bigelow, PO Box 524, Williamstown VT 05679. (802) 433-5567.*

WILLIMANTIC CT
SEPT 24

The 7th annual Natchaug ARC giant flea market will be held at the French Club on Club Road. Dealers. Free parking. Admission $2, under 16 free. Advanced, inside tables $6, $8 at the door. Tailgating $5 and up. ARRL/VEC exams for all classes. Talk-in on 90/30. Contact *Pat Rogowski N1GBP, 90 Becker Circle, Windsor CT. (203) 522-8028 evenings.*

ELMIRA NY
SEPT 30

The Elmira ARA will present the 14th Annual Elmira International Hamfest at the Chemung County Fairgrounds. Outdoor flea market, indoor dealer displays of new equipment. Tickets available at gate or in advance from *Dave Lewis, RD #1, Box 191, Van Etten NY 14889. Don Estus, (607) 739–4807.*

NORTH WICHITA KS
SEPT 30–OCT 1

The Kansas State ARRL Convention will be held at the Red Coach Inn by the Wichita ARC. Features Flea market, dealers, VE Exams, forums, banquet Saturday night, breakfast Sunday morning. Talk-in: 146.22/.82 and 146.34/.94. Pre-registration $5, door $6. Flea market table, $6. *Vern Heinsohn WA0ZWW, 950 Backbay Blvd., Wichita KS 67203.*

Special Events Stations

PANAMA
SEPT 2–3

The Radio Club of Panama celebrates the 18th anniversary of their club with an HF-bands contest the hours of 00:01–23:59 GMT. Bands assigned: 15 mts; 20 mts; 40 mts. Contest callsign: CQ CONCURSO DEL RADIO CLUB DE PANAMA; CQ CONTEST FROM RADIO CLUB OF PANAMA. Authorized stations: HP1-LD; HP1-BSL; HP1-ECA; HP1-AIB; HP1-CDW; HP1-CDZ.

NEWNAN GA
SEPT 2–4

The Bill Gremillion Memorial Radio Club will operate K4SEX at 1400–2000 UTC in conjunction with the 20th annual Powers Crossroads Arts & Craft Festival. Suggested frequencies: 14.325; 21.325; 28.325. For QSL send QSL and SASE to *BGMRC, PO Box 2327, Newnan GA 30264.*

SCHAUMBURG IL
SEPT 3

The Schaumburg ARC will operate WB9TXO at 1500Z–2100Z from their demo station at Schaumburg Septemberfest. Suggested frequencies: 7.289; 14.289; 21.289; 28.389. For special certificate send QSL to *SARC, PO Box 68251, Shaumburg IL 60168-0251.* For info contact *John Seal (312) 887-1800 X-126 or (312) 830-8727.*

BILLINGS MT
SEPT 4–9

The Yellowstone Radio Club of Billings is sponsoring a special event to coincide with the Great Montana Cattle Drive to commemorate the Montana Centennial. Listen for stations identifying themselves as "The Great Montana Cattle Drive" with their individual callsigns. Hours will be 1400Z–2400Z each day. Suggested frequencies: 7265 kHz, 14265 kHz and 21365 kHz USB. For commemorative certificate send QSL with info and a 9 x 12 SASE to *Verlon Cox K7AEZ, 1124 Parkhill Drive, Billings MT 59102.*

LOST PENINSULA MI
SEPT 9–10

The Oliver Hazard Perry Expeditionary Force (WD8LKI) will begin operations from the Lost Peninsula Sept. 9th at 13H00Z. Suggested frequencies: 28.365, 21.365, 14.265, 7.265 and 3.965 MHz. To find the Lost Peninsula, send your QSL and a 9x12 SASE to *Como Wills, 30372 Bates Road, Perrysburg OH 43551.* For additional info contact *Robert F. Solon WD8LKI, PO Box 8526, Toledo OH 43623. Work (419) 475-8665, Home (419) 537-9255.*

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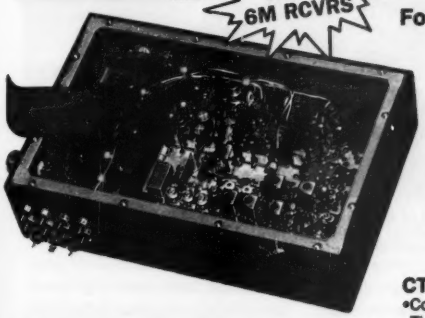

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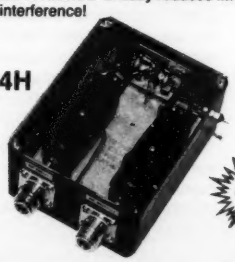

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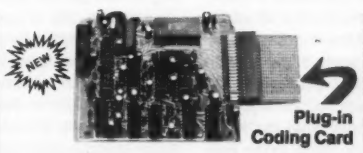
CTC100 Rptr. COR Timer/Control Bd.

- Complete solid state control for rptr. COR,"Hang" Timer, "Time-Out" Timer, TX local & remote Shut-down/Reset, etc.
- Includes inputs & outputs for panel controls & lamps.

Power Supply Boards

NEW

- **SCP12** 12 VDC @ 0.3A MAX. OUT.
- **SCP512** 12 VDC @ 1A & 5VDC @ 0.4A out. (1.1A total max. out.)
- **SCP512A** As above, but also w/−12VDC @ 0.1A



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TTC300 TOUCH TONE CONTROLLER

- High performance, Super versatile design. To control any ON/OFF Function at a remote site via DTMF Radio Link.
- Uses new high quality Xtal Controlled Decoder IC, w/high immunity to falsing
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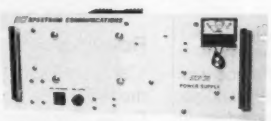

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- 30A @ 70% duty, 25A @ 100% duty.
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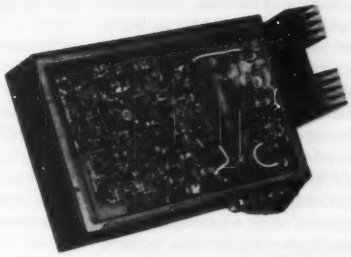

Improved SCT410B Transmitter Assy.

SCT110 VHF Xmtr/Exciter Board

- **10 Wts. Output. 100% Duty Cycle!**
- Withstands High VSWR
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- **BA75 75 Wt. unit also available**

SCT110 Transmitter Assembly

- ***SCT110 mounted in shielded housing***
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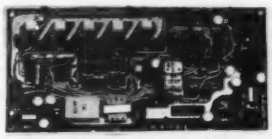

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"When You Buy, Say 73"

CIRCLE 51 ON READER SERVICE CARD

73 INTERNATIONAL

edited by C.C.C.

Notes from FN42

Names of nations. Burma has just renamed itself; it is now Myanma, with emphasis on the second syllable: Mee-ahn-ma. Cambodia, which became Kampuchea a few years ago, is Cambodia again. There have been many such name changes in recent decades, in Africa particularly. Perhaps we should do a rundown in a future column? With explanations, perhaps? Like, Upper Volta became Burkina Faso five years ago—why? Oh, well; we're lucky compared to school children in Myanma who have to learn that they live in the Pyidaungsu Socialist Thammada Myanma Naingngandaw.

Interested in inviting someone from the USSR to come visit? Bryan Hastings NS1B, Editor in Chief, *73 Amateur Radio,* is, and phoned the USSR Embassy. They responded by promptly sending him a short application in English and Russian. Those interested should write or phone the Soviet Embassy or Consulate in your country. (In the US, 1125 16th St. NW, Washington, DC 20036; (202) 628-8548.)

Radio broadcasting freedom continues to spread as, believe it or not, the Voice of America now has a Moscow Bureau with full-time staff. The once-clandestine Radio Liberty (RL) and Radio Free Europe (RFE) of OSS (Office of Strategic Services) and its successor, the CIA, now have in their employment a Moscow freelancer airing a regular review of what is in the Russian press, called "At the Kiosk." VOA even has talk shows which allow Russian listeners to call in with questions and comments. *Glasnost* is also permitting KOL Israel and Deutsche Welle to be heard. (From *The Economist*, and from *Die Zeit* in *World Press Review*.) Radio France International has announced a 45 percent increase in broadcasts to the USSR, Poland, Romania, and Yugoslavia; and Mr. Varbanskiy (first deputy chief of the USSR Ministry of Communications Space and Radio Communications Main Administration) has stated that equipment previously used for jamming now is used to shortwave relay programs to Moscow listeners. (From Robert Chear, France, and Karel Honzik, Czechoslovakia, in *Sweden Calling DXers.*)

In China, however, after two long steps forward there has been what we can only hope is just a single step back—but it was a tragic one. After the severe repressions in early June, a VOA correspondent was given 72 hours to leave the country. One can only wonder what the future will bring. References to the People's Republic of China in this column—if any—will be of a very general nature for a while. . . .

Reflections. When electricity replaced gaslight fixtures in the legislative chambers of the State of Washington, many legislators were nervous enough so that printed signs went up at the doors: Electric Lights Are Not Hazardous To Your Health.... I have a personal memory of the first time my grandfather used a wall crank telephone: He stood well away from the wall and yelled at it, meanwhile holding the receiver a safe six inches away from his ear.... In the 1930s a friend of mine got a letter from an acquaintance in Bogota, Colombia, saying he was going to telephone him on a certain date at a certain time, and what number should he call. To be sure everything worked out, my friend got a hotel room in Boston and alerted the staff. The manager himself supervised the hotel switchboard—and the call came in as scheduled after a series of operators exchanged their own messages. As he checked out the next day, the doorman asked him if his call had come in OK.... I gave my then-86-year-old father an electronic calculator ten years ago; it was weeks before he stopped checking up on its answers with pencil and paper—and he never had any real confidence in it.... As for me, as I reach 70, well, never mind! Let's just say I don't actually shake malfunctioning appliances in case the electricity has gotten clogged up in some wire somewhere. . . . RP

Yuri UA4LCQ/UG6 of Expedition SOS Armenia operating in the Leninakan/Spitok/Kirovokan area, December 1988–January 1989. (Photo from Ken Carpenter KC4UG.)

Calendar for September

1—Army Day, Chile
3—Independence Day, Qatar (7th for Brazil, 15th for Guatemala, El Salvador, Costa Rica, Honduras, and Nicaragua, 16th for Mexico and Papua New Guinea, 18th for Chile, 21st for Belize)
4—Labor Day, USA; Labour Day, Canada
6—National Day, Switzerland (10th for Belize, 11th for Chile, 26th for Yemen Democratic Republic)
8—**World Literacy Day.** Teach somebody "Have a good day" in *your* language today!
9—National Liberation Day, Bulgaria
12—Revolution Day, Ethiopia
15—Respect for the Aged Day, Japan
17—National Heroes Day, Angola
20—Federal Thanksgiving Day, Switzerland
23—National Holiday, Saudi Arabia
24—Anniversary of Third Republic, Ghana; Autumnal Equinox Day, Japan
25—Referendum Day, Rwanda
26—Confucius Day, Taiwan
30—Botswana Day, Botswana

Roundup

South Africa. The callsign for the Antarctica Sanae Research Center has been changed from ZS1ANT to ZS7ANT to make it more distinctive.

A radio amateur convention will be held in Johannesburg next March, according to Hans v. d. Groenendaal ZS6AKV, chairman of the Johannesburg Branch of the South African Radio League (SARL)—the largest of the SARL branches, with over 500 members. To be scheduled at the same time as the national AGM of SARL, it will have international guest speakers and seminars and discussion groups on many subjects including DX, packet, SWLs, and satellite operations.

The SARL publication, *ZS6TJ Calling,* was rated "Excellent" in Category A (publications of groups with over 500 members) in the 1988 *Amateur Radio News* Service Publications Contest.

Marion Island background: For months before the Marion Island team departed last April for its planned 14 months of isolation, members received both specialized and general training, including psychological preparation for the experience. Peter Sykora ZS6PT (operating as ZS8MI) said he wasn't worried—he'd have plenty of work to do, including installation of an automatic weather-recording station. "There are after all seven of us," he said, "and I have Amateur Radio. I am sure that I will take time off to ragchew to my friends. . . . I hope the DXers will give me time off to have some leisurely QSOs!"

The Northern California DX Foundation provided two Yaesu FT757 GX2 transceivers, a FL2100 amplifier, and the power supplies for the DXpedition; Hal Lund ZS6WB provided an ICOM 8-metre transceiver, and two 4-el yagis. Peter will be using two rhombics and two V-beams also, which will be used for commercial operation between the island and Pretoria. He has an AEA PK232 TNC and IBM-compatible computer for logging and transfer of logs to ZS5E, his QSL manager. He hopes also to fire it up to work AMTOR and HF packet.

USSR. The reports we hoped to get from around the world on the

Armenian earthquake disaster never materialized, but see the photo for a picture of Yuri UA4LCQ/UG6 operating in the area.

ISRAEL

Ron Gang 4X1MK
Kibbutz Urim
Negev Mobile Post Office
85530 Israel

Callbook Foul-up. We don't know who is to blame, but in the 1989 *International Callbook* Israeli Novices who have upgraded have **Silent Key** listed next to their old Novice callsigns. Only the callsigns have passed on, and their previous owners now sport new calls that you'll have to search for elsewhere among the 1300 or so Israeli calls listed. *We can assure you,* those named next to the call-letters listed here (see the box) are alive and well!

All Novices are now 4X9s. The last stage of callsign restructuring has gone into effect. Novices used to be 4X4N- -, 4Z4N- -, and 4Z6N- -, with the N dropping out when they upgraded to Grade B (General Class). For a few years, the new Novices got a 4Z9- - - call, the ones with UHF all-mode privileges getting a 4Z9B- - ticket. The Ministry of Communications has finally recalled the old N- - calls, but gave no assurance that they wouldn't be reissued later—thus prodding the old Novices to upgrade! Prefix hunters may find the 4X9 calls on the Israeli Novice bands from 7.000 to 7.050 and 21.100 to 21.150 MHz CW, as well as (conceivably) on OSCAR Mode B, as Novice Enhancement here has given 25 watts output to all modes on the 70-cm band.

Alive and Well!
4Z4NZR, 4X6NDE, 4X6NFK, 4X6NFS, 4X6NKV, 4X6NRG, 4X6NRP, 4X6NUN 4Z9AAC, 4Z9ACD, 4Z9ADD, 4Z9AEB, 4Z9BBA, 4Z9BBC, 4Z9BCB, 4Z9CEB, 4Z9DBA, 4Z9DDD, 4Z9DED (*definitely not ded—ccc*), and 4Z9EAA.

Jerusalem's 4Z4SW, its only presently active club station, opened early in March. Rich 4X1DA was the moving force and Elmer, setting up the station at the Giloh Home for the Handicapped. Once a week he runs a class teaching residents to make QSOs on the air and steeping them in Morse code and radio theory. He had three hot prospects for exams in April. The station has a Kenwood TS-130 driving a 3-el tri bander 15 meters up on one of Jerusalem's higher spots. He is looking for volunteers to help out and bring more joy into the lives of the residents; anyone with time and good will is encouraged to get in touch with 4X1DA (previously 4X6DA).

Packet telephone. A packet BBS has been instituted by 4X4XX, 4Z4AB, and 4X6LM on "the twisted pair" for the use of IARC members, and can be accessed by dialing (03) 512-5396 daily between 1600 and 1730 local time, and from Thursdays at 1600 through Sundays at 0730. It works with a modem running at 1200 baud, and you don't need a ham license to access it! What can you find on the BBS? A mailbox, DX bulletins, technical articles, letters via packet radio, and files dealing with amateur radio. Why a BBS on the telephone? Shlomo 4X6LM says that it clears up the congestion on 146.675 MHz and lets those who don't have all the peripheral gear get in on the fun. And, finally, why not have one?

The Silent Keys' Forest is three years old now, and there are three thousand saplings growing there. It is in the Ben Shemen forests, about five km east of the Ben Gurion International Airport. The Israel chapter of the Quarter Century Wireless Association (QCWA) established the Amateur Radio Forest to provide a living memorial to our dear departed ones by creating forests on the hilly areas that had become bare from centuries of over-grazing and neglect.

The Ministry of Communications has issued the callsign 4X4SKF which may be used by any group operating a station there, and the IARC has activated the call on many occasions when field days or picnics have been held in the forest.

Hams and families all over the world as well as in Israel are invited to plant trees in the Silent Keys' Forest. The procedure is as follows: Send a check for US $5 for each tree you wish planted, payable to the Keren Kayemet Le'Israel (The Israel Forestation Authority). Write on the back of the check or on a separate piece of paper the name and callsign of the amateur to be remembered, and the name and callsign (if appropriate) of the donor. Mail it to the Authority, attention of Mrs. Vicky Alkalay, PO Box 283, 91002 Jerusalem, Israel. A handsome certificate suitable for framing and hanging on the hamshack wall will be sent to the donor. (Israeli donors should check to see if the current six-shekel donation per tree is still the right amount.)

Shimshon 4X4GF (Gefilte Fish) has suggested that 70 trees would make a most fitting donation. 73s—get it?

The annual IARC social event saw some 650 people gathered together in a banquet hall that two hours before the event was empty. Around 20 IARC volunteers then went to work putting tablecloths on bare tables, unloading hundreds of kilos of food and soft drinks from 4X4AT's van and prizes from 4X6OM's tender, and setting up the stage and sound system. At the appointed hour, the place looked as if professional caterers had been at work. (IARC members note: if you have been taking the organization's services for granted, now you know what goes on behind the scenes!)

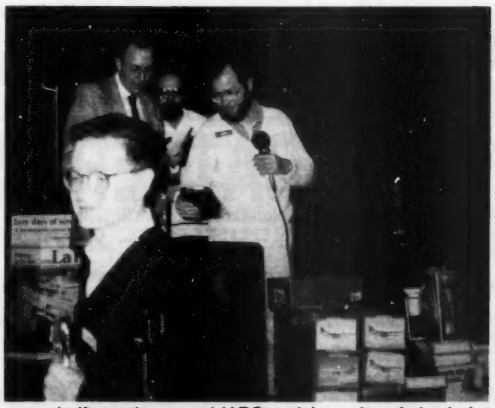
The IARC General Secretary, 4X1AT, and 4X4AH, the honorary president, spoke, as did Monya Adan, an Old Timer radio pioneer who related tales of early communications networks in the settlements of pre-State Israel. In 1924, semaphore flags were used by day and flashlights at night, but during the Arab riots a wireless net was established. The British Mandatory authorities required a license to own a radio receiver, and transmitters were illegal, with hanging being the maximum punishment for getting on the air.

A private company in Tel-Aviv began building transmitters for the clandestine use of the Hagana (the Jewish Defence Organization), but there was trouble with the rigs, and as Monya became interested in radio, he studied amateur radio literature and started building small transmitters that became the backbone of the 1938 Hagana radio network. The network coordinated the illegal immigration operation, running the British blockade of the coast of Palestine and bringing in refugees from Hitler's death camps in Europe.

Monya issued himself the callsign ZC6MOM, one of quite a number of pirate ZC6s, and a friendly British officer, a ham, surreptitiously brought them QSLs!

Egan Ron 4X4RE (ZC6RE in 1947), issued Israeli passport #2002, told of organizing a DXpedition to the island of Rhodes in 1952 which didn't work out, but in 1956 when Israel occupied the Sinai Peninsula, he received the callsign 4X5RE, made 800 contacts from Sharm-el-Sheikh, finally completing a successful DXpedition. However, the DXCC did not recognize the operation! You can't win!

The long-awaited raffle followed the program. The stage was loaded with the goods obtained by IARC volunteers who had been pestering prospective donors for months. The best prizes were two airline flights overseas, a Mediterranean cruise, and two 2-meter handie-talkies from ICOM and Alinco, newcomer firms to the Israeli ham market. The bottom line was that income from the draw was sufficient to pay for the cost of the evening!



Prizes and gifts at the annual IARC social evening. At back, L to R, 4X6KJ, 4Z4AB, and 4X1MK. A happy winner slips into the photo, foreground, unexpectedly. (Photo by 4X1GE.)

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New Zealand

NOTE: A new address for the NZART National QSL Bureau: PO Box 35–046, Naenae, Wellington, NZ.

From June 1 of this year through to 19 February, 1990, ZL amateurs may use the callsign prefix ZM to promote the XIV Commonwealth Games to be held in Aukland in early February, 1990. Furthermore, there will be a special "Games" station, ZM14CG, established in the "Games Village" and staffed by members of the Auckland branches of the New Zealand Association of Radio Transmitters (NZART). The station will issue a special commemorative QSL card for contacts made with it. Operations will be on all bands, and visiting amateurs will be welcome at ZM14CG.

For further information, write Robert Jeffares ZL1BTR, 34 Amy Street, Ellerslie 1105, Auckland NZ.

The XIV Commonwealth Games Award, sponsored by NZART, will be available to radio amateurs worldwide. It is also a part of New Zealand's 150th Year Celebrations. Contacts between last June 1 and 10 February, 1990, will be eligible, and the requirements are as follows: Contacts with five (5) ZM1 stations, one (1) each with ZM2, ZM3, and ZM4 stations, plus one (1) with a Commonwealth country in each of Regions I, II, and III for a total of eleven (11) contacts. Logs must be verified and certified by two other amateurs, and sent to The Commonwealth Games Award Manager, Aola Johnston ZL1ALE, 63 Red Hill Road, Papakura 1703, NZ.

Terry Carrell ZL3QL has been re-elected NZART President by a large majority vote of the members. New councillors also were elected, and the new team met for the first time June 3/5.

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CIRCLE 440 ON READER SERVICE CARD

QRP

Continued from page 81

the shaft to the capacitor, using a cut-off piece of pot shaft and some five-minute epoxy. I sanded both surfaces to rough them up, allowing the epoxy to get a better hold on the metal. Be sure that both pieces are clean and free of oil.

You'll need to go through a trial and error process to get the right length of shaft. I used some double-sided tape to secure the capacitor to the cabinet. You might want to try more epoxy to glue the capacitor down. A bit more work and you could mount the capacitor to a small piece of copper PC board, then mount the board to the cabinet. The choice is up to the individual builder—use whatever method works for you. Just be sure that you don't thread a longer screw than is supplied into the capacitor. This will short out the plates and ruin the variable capacitor.

In the old days, you could use a panel-mounted bearing to hold the shaft. Now you just can't find these bearings anywhere. So, I used a rubber grommet. This worked quite well, even though it was a bit loose.

Testing

Check over your wiring. Since there is not much to go wrong, we can move right up to testing out the meter. Couple a small amount of RF to the telescopic antenna. (I just placed the antenna near my open-line feeders.) Key up the transmitter and adjust the tuning capacitor for a peak meter reading. Make sure that you've got S-1 set to the proper range. Of course, don't tune up on the air except for short durations. That's about all there is to it! Tuning up that antenna for Field Day should now be much easier. I'm sure that the tuned field-strength meter will find a home in your tool box.

New from Ten-Tec

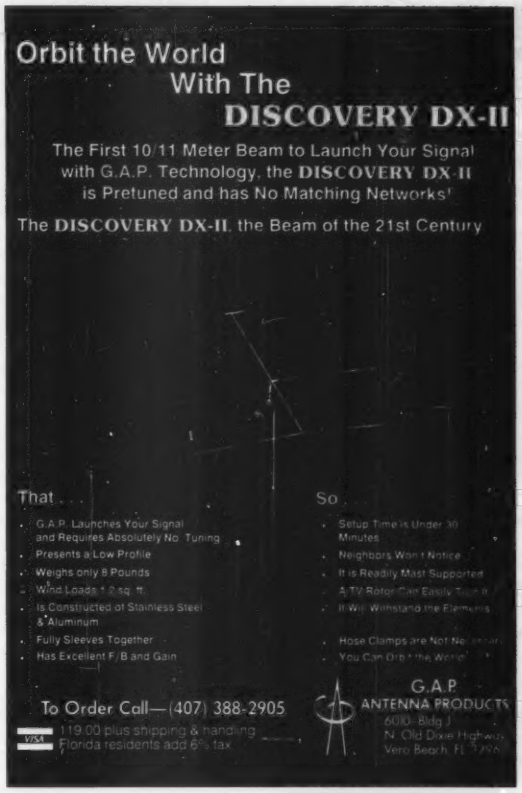
Some of the highlights of the new Ten-Tec Argonaut II: PLL tuning, 25 memories, LCD display, general coverage receiver, all ham bands (WARC), VOX, noise blanker, key pad input of frequency, five Watts input, and of course the famous Ten-Tec QSK CW. The Argonaut II is much smaller than the original. You can put one inside a small briefcase for some spy radio operation. Look for a review of the new Argonaut II in a upcoming issue of *73*. List will be around $900.

I'm very glad to see that Ten-Tec came out with this new QRP radio. As most of us know, Ten-Tec started out with QRP and has always led the pack with quality products for the low power operator. I wish them the best of luck with the new transceivers. Remember, you read about the new Argonaut here first!

Heath HW-9 Mods

I'm still looking for modifications for the Heath HW-9 for the third edition of the *Hot Water Handbook*. Send them to me at the address above. If I use yours in the book, you'll receive a free copy! Don't worry about the modification being too simple or too complex. I'm interested in all of them.

Until next month, slow those electric meters down! Operate QRP. Split logs, not atoms. 73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LETTERS

From the Hamshack

Zap!

The article featured in the July issue titled "Microwave Oven Transmitter" indicates it is time for your staff to get a "check-up from the neck up!" Building and/or operating this instrument of destruction subjects not only the operator but also innocent people to irreparable if not fatal microwave radiation. Commercial studio transmitter links usually don't run in excess of 10 watts, yet you offer the means of 500! Operating such a device within city limits without a doubt poses a health hazard to any living creature and will destroy the credibility of the amateur radio fraternity. Many "dish" ordinances which were overruled would now have the grounds to be reinstated.

Proper operating practices dictate using only the amount of power required to establish the contact. Your article contradicts this very basic guideline, where at 10 GHz contacts of several hundred miles were made with power levels of 1 watt or less!

I think it's time to use a bit of editorial common sense and trash articles of this type.

Please inform me as to which issue I can expect to see plans for a thermo-nuclear device. This will prove very useful to those studying the electro-magnetic pulse generated by these devices.

Bob Kozlarek WA2SQQ
Elmwood Park NJ 07407

Bob, we share your valid concern—hence the stern warnings in the article about the danger involved in building and operating the microwave oven transmitter. Comparing it to a thermo-nuclear device, however—even with your edge of black humor in it—is far-fetched!

Put matters into perspective. There are many devices in regular use in our society as dangerous as, or more so than, the microwave oven transmitter—cars and guns to name just two. Just as licensed drivers and (at least some) gun-owners earned the right to operate their devices, hams earned the right to transmit on a given set of bands with a given set of power out maximums—which for 13cm is up to 1000 watts. The FCC obviously considers us responsible enough to safely handle this.

As it turns out, there are times when several hundred watts is the minimum power required to make the contact—notably in Earth-Moon-Earth (EME) work. Path losses in 13cm EME work are enormous—typically 278 dB, when the moon is at apogee. The first design consideration that the 1989 ARRL Handbook *(page 23-28) gives for EME work is that "transmissions must be made on CW or SSB with as close to the maximum legal output as possible."*

Even though our microwave bands face a very serious threat from spectrum-hungry commercial interests, most are still virtually unused. High cost and hard-to-get components have long been problems—which the microwave oven transmitter project neatly eliminates on 13cm. There's more reason than ever for us to get active there—and the sooner the better! . . . *NS1B*

Advertising

I'm writing in response to Wayne's question posed in your editorial pages about allowing the Lambda Amateur Club to advertise for members in ham publications. I cannot for the life of me even see why this is being made an issue of. The Lambda club is not to promote their lifestyle or in any way recruit new homosexuals from the amateur community. What they are doing is simply let gay hams know of their existence and allow operators to seek more information on the club and its activities. And they have every right to do this.

Whether the group is straight or gay is irrelevant. What is important is that they work to promote the Amateur Radio Service and maintain high operator standards.

Robert A. Siddons NS2V
Margaretville NY 12455

Successful Proselytizing

For the time being, the code requirement exists for all license levels, and so the need to teach it. One effective method I found is to bury "treasure" and conduct a hunt. I bury a few dollars worth of coins in the city park and then hand out to interested kids tapes of directions, in slow code, to find the money.

Does it work? Yes! Competition from the peers helps plenty as well. If you want to try this, just keep the directions darned short! Good luck!

Michael Simmons WB9CWE
Charlestown IL 61920

UPDATES

Addresses for "Decoding OSCAR Telemetry"

In "Decoding OSCAR Telemetry," Parts I and II, by James Miller G3RUH, in the May/June 1989, issues of *73*, the following list of names and addresses for article references was inadvertently omitted:

AMSAT-NA, PO Box 27, Washington DC 20044. Tel: (301) 589-6062.

AMSAT-UK, 94 Herongate Road, Wanstead Park, LONDON, E12 5EQ, England. Tel: +44-1-989-6741. Accepts Visa/MasterCard.

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ARRL, 225 Main Street, Newington CT 06111. Tel: (203) 666-1541. Accepts Visa/Mastercard.

James Miller G3RUH, 3 Benny's Way, Coton, Cambridge, CB3 7PS, England. Tel: +44-954-210388. Accepts bankdraft, traveller's cheque, Eurocheque.

Pac-Comm Packet Radio Systems, Inc., 3652 West Cypress Street, Tampa FL 33607-4916. Tel: (813) 874-2980. Accepts Visa/Mastercard.

Project Oscar, PO Box 1136, Los Altos CA 94023-1136. Tel: (415) 591-4896.

RadioKit, PO Box 973, Pelham NH 03076. Tel: (630) 635-2235. Accepts Visa/Mastercard.

UOSAT Spacecraft Engineering Research Unit, Dept. of Electronic Eng, University of Surrey, GU2 5XH, England. Tel: +44-483-571281.

"QRP CW Transceiver" Schematic

Note the schematic on page 21 of the June 1989 issue of *73*. The following corrections apply:

1. The schematic incorrectly shows a jumper from T2 to U2. It should go to U1. Note that this is only a jumper on the schematic and that there is no such corresponding jumper on the board.
2. C42 and R42 should be connected to pin 3 of U1, not pin 4. Pin 4 is open, except for its connection to pin 8.
3. The tap for L1 should be 8 turns up from ground.
4. The tap for L6 should be 8 turns up from ground.
5. The secondary winding for T2 should have 5 turns.
6. The drain of Q6 should be labeled. It is the lead connected to T3.
7. C47 is incorrectly listed on the parts list as 47 pF. It should be 47 mF.
8. An extra trimmer cap on the parts placement guide in the VFO is shown which is not assigned a value. Ignore this and the pads used to add capacitance to the VFO. It is not strictly necessary.
9. The layout shows C40 as 47 pF. It should be 47 mF.
10. The layout shows R13 as 10k. It should be 100k, although it is not critical.
11. C29 is shown on the schematic as an electrolytic, but not on the layout. It doesn't matter if it's electrolytic or monolithic, but if electrolytic is used, observe the polarity.
12. C2, the main tuning capacitor, is listed in the parts list as 35 mF. It should be 35 pF.
13. C23 is omitted from the parts list. It should be a 6–50 pF trimmer, just like C18.
14. There are several instances of 0.1 caps being listed as 0.01, and vice versa. All of these have been researched and the builder can use either. These values are not critical. 73

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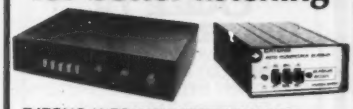

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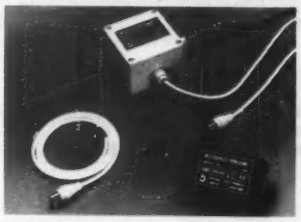

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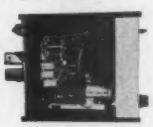

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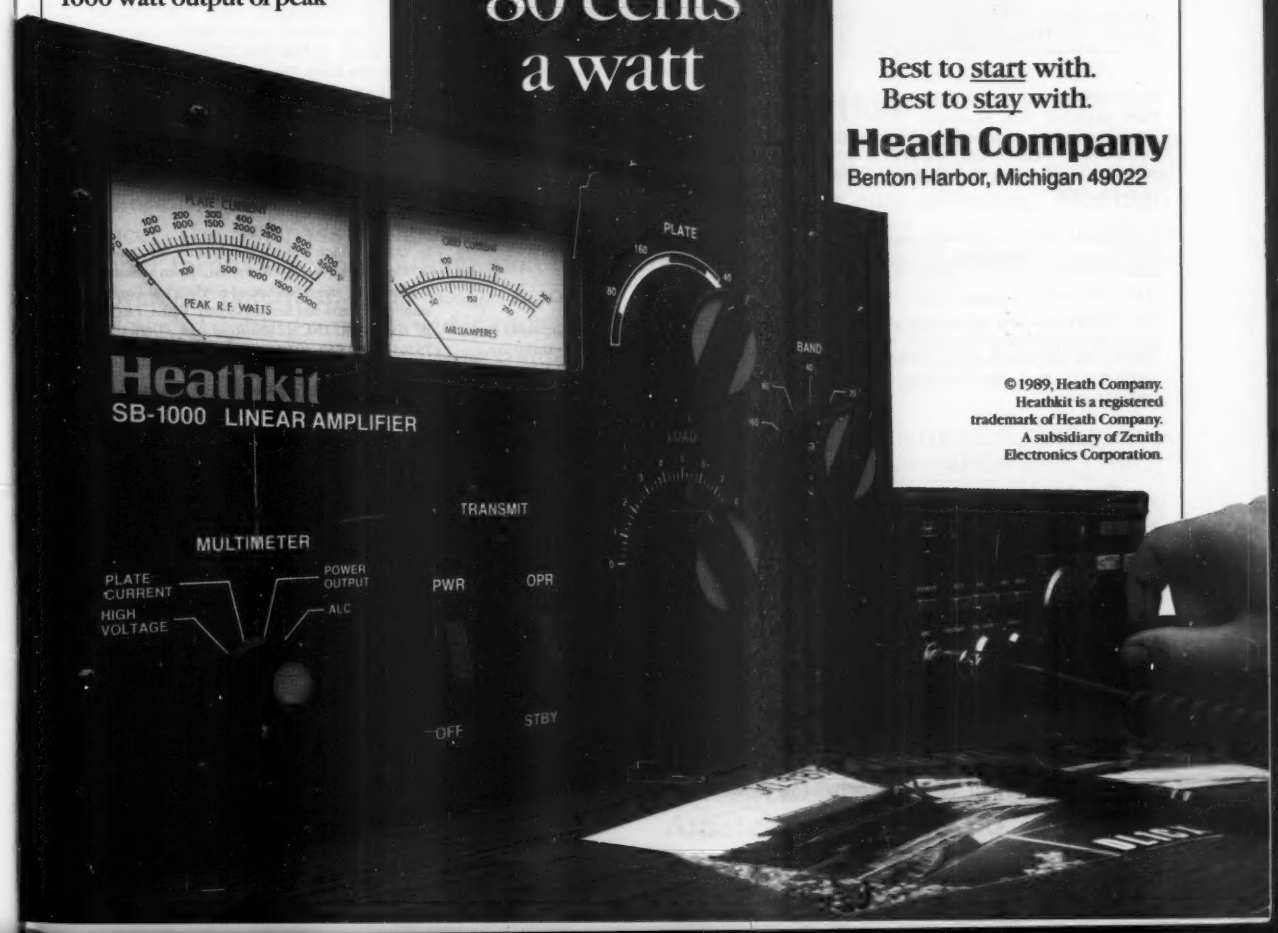

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PROPAGATION

Jim Gray W1XU

Jim Gray W1XU
PO Box 1079
Payson AZ 85541

A Stormy Month

September's forecast is one of those in which I hope I am totally wrong, but I won't count on it! Propagation for this month will be very mixed up, indeed. Although September is the beginning of unusually excellent fall DX conditions—Solar Cycle 22 is rapidly approaching peak sunspot numbers—the HF bands may be very disturbed, to say the least, for much of the month. While solar flux will be high, you may expect exceptional activity in the form of flares, proton events, polar cap disturbances, and the like. These will have a definite effect on propagation. It's too early to tell what will be affected the most (this is being written in June), but use the chart of daily conditions for a guide.

Unusual weather conditions may also take place on many days of the month, and interesting geophysical effects may occur from time to time. Expect the earth's magnetic field to be unsettled to active, and up to storm levels on many days. Propagation conditions on the HF bands should improve remarkably in October, however, so we'll just have to grin and bear it for this month. Keep a sharp lookout for aurora and unusual VHF propagation on 6 meters and above.

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	15*	20	20	20	—	—	—	—	—	—	—	15*
ARGENTINA	15	15	20	20	40	—	—	10	—	—	10	10
AUSTRALIA	10	15	20	20	—	40	20	20	—	—	—	10
CANAL ZONE	15	40*	40*	40*	40*	—	20	10	10	10	10	10
ENGLAND	20	40	40	40	—	—	20	10	10	10	15	20
HAWAII	10	15	20	20	40*	40	20	20	—	—	—	10
INDIA	20	20	—	—	—	—	—	15	—	—	—	—
JAPAN	15*	20	20	20	—	—	—	—	—	—	—	15*
MEXICO	15	40*	40*	40*	40*	—	20	10	10	10	10	10
PHILIPPINES	—	—	20	20	—	—	20	15*	15*	—	—	—
PUERTO RICO	15	40*	40*	40*	40*	—	20	10	10	10	10	10
SOUTH AFRICA	40*	20	20	20	—	—	—	—	10	10	10	15
U.S.S.R.	—	40	20	20	20	—	—	10	10	15	20	20
WEST COAST	10	15	20	20	8/18	8/18	—	—	—	10	10	10

CENTRAL UNITED STATES TO:

ALASKA	10	15	20	20	20	—	—	—	—	—	—	—
ARGENTINA	15	15	20	20	20	—	—	10	—	—	10	10
AUSTRALIA	10	15	15	20	20	40*	40	20	—	—	15	10
CANAL ZONE	15	15	20	20	—	40	40	10	10	10	10	10
ENGLAND	—	—	—	—	—	—	10	10	15	15	20	20
HAWAII	15	15	20	20	40*	40*	40	20	—	—	10	10
INDIA	—	20	—	—	—	—	—	20*	15	—	—	—
JAPAN	10	15	20	20	20	—	—	—	—	—	—	—
MEXICO	15	15	20	20	—	40	40	10	10	10	10	10
PHILIPPINES	15	—	—	—	—	—	—	20	10	10	—	—
PUERTO RICO	15	15	20	20	—	40	40	10	10	10	10	10
SOUTH AFRICA	20	20	20	—	—	—	—	—	10	10	15*	15
U.S.S.R.	—	—	20	—	—	—	—	20	15	15	20	20

WESTERN UNITED STATES TO:

ALASKA	10	15*	—	20	20	20	20	20	20	20	—	15
ARGENTINA	10	15	15	20	20	20	—	—	10	—	10	10
AUSTRALIA	10	15*	15*	20*	20	20	40	—	—	—	—	10
CANAL ZONE	10	15	15	8/18	8/18	—	—	—	15*	10	10	10
ENGLAND	—	—	—	—	—	—	—	—	—	15	20	15
HAWAII	10	10	15	20	40*	40*	40	40	15	15	—	15
INDIA	—	8/10*	—	—	—	—	—	—	—	8/10*	15*	—
JAPAN	10	15*	—	20	20	20	20	20	20	20	—	15
MEXICO	10	15	15	8/18	8/18	—	—	—	15*	10	10	10
PHILIPPINES	10	10	—	—	—	—	—	—	20*	15	15	—
PUERTO RICO	10	15	15	8/18	8/18	—	—	—	15*	10	10	10
SOUTH AFRICA	20	20	—	20	—	—	—	—	—	10	15	15
U.S.S.R.	—	—	—	20	20	—	—	—	15	15	20	20
EAST COAST	10	15	20	20	8/18	8/18	—	—	—	10	10	10

* Try next higher band (1) Difficult path

SEPTEMBER

SUN	MON	TUE	WED	THU	FRI	SAT
					1 F	2 F-P
3 P	4 P	5 P-F	6 F	7 F-P	8 P	9 P
10 P-F	11 F-G	12 G-F	13 F	14 F-G	15 G	16 G-F
17 F-P	18 P	19 P	20 P	21 P-F	22 F	23 F-P
24 P	25 P	26 P	27 P	28 P-F	29 F-P	30 P

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- PS-430/PS-3D DC power supply
- SP-430 external speaker
- MB-430 mobile mounting bracket
- YK-88C/88CN 500 Hz/270 Hz CW filters
- YK-88S-88SN 2.4 kHz/1.8 kHz SSB filters
- MC-60A/80/85 desk microphones
- MC-55 (8P) mobile microphone
- HS-4/5/6/7 headphones
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